

## HAZARDOUS MATERIALS RESPONSES

**Request #53** - Please provide an offsite consequence analyses for aqueous ammonia including accidental release modeling as described in Section 5.12.3.4 of the Application for Certification.

**Response #53** - The Inland Empire Energy Center (IEEC) is required by both the Clean Air Act and the South Coast Air Quality Management District to install Best Available Control Technology to control emissions of criteria air pollutants from the combustion turbines. The IEEC turbines will incorporate dry low NO<sub>x</sub> combustors that reduce emissions of oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), and volatile organic compounds (VOC). In addition, the turbines (and duct burner) emissions of NO<sub>x</sub> will be further reduced through the use of selective catalytic reduction (SCR). The SCR control system utilizes ammonia as the reduction medium in the presence of a catalyst. Two forms of ammonia may be used in currently designed SCR systems, i.e., anhydrous ammonia or aqueous ammonia. The IEEC facility is proposing to use aqueous ammonia in a 28.0% (by weight) solution. Chapter 3.0 of the AFC contains a detailed description of the facility location and process data. Figure 3.3-2 (Chapter 3.0) shows the facility site plan. The aqueous ammonia tank is delineated as structure "14". Aqueous ammonia is a water based ammonia solution, which can be mixed and delivered, in a wide variety of solution ratios. Solution mix ratios less than 30% (weight basis) are the most common. Aqueous ammonia solutions typically have a boiling point of approximately 83 deg F. When spilled, aqueous ammonia solutions will slowly vaporize, releasing ammonia vapors. According to data prepared for the CEC by Ebasco (*Ammonia Release Risk Mitigation Guidance for Power Plants-Draft Report, November 1989*) when ammonia is diluted with water to solutions of less than or equal to 20% by volume, evaporation of ammonia gas from the fluid becomes negligible. The guidance further states that when ammonia is diluted with water at ambient temperatures to solutions less than 25% by weight, ammonia vapor pressure is reduced to atmospheric pressure, i.e., the evaporation of ammonia gas from the fluid would be negligible.

The Code of Federal Regulations 40 (CFR) Part 68 and California Code of Regulations (CCR), Division 2, Chapter 4.5 regulate the potential accidental release of hazardous materials. Article 8, Section 2770.5 includes tables of federally (Tables 1 and 2) and state regulated substances including threshold quantities for regulation under the accidental release prevention program. Because IEEC will store ammonia in excess of 500 pounds (see Table 3), IEEC is required to complete an Off-Site Consequence Analysis that is included below.

Accidental releases of ammonia (all forms) in industrial use situations are rare. Statistics compiled on the normalized accident rates for RMP chemicals for the years 1994-1999 from *Chemical Accident Risks in U.S. Industry-A Preliminary Analysis of Accident Risk Data from U.S. Hazardous Chemical Facilities*, J. C. Belke, Sept 2000, indicates that ammonia averages 0.017 accidental releases per process per year, and 0.018 accidental releases per million pounds stored per year. Data derived from *The Center for Chemical Process Safety, 1989*, indicates the following accidental release scenarios and probabilities for ammonia in general.

Accident Scenario	Failure Probability
Onsite Truck Release	0.0000022
Loading Line Failure	0.005
Storage Tank Failure	0.000095
Process Line Failure	0.00053
Evaporator Failure	0.00015

IEEC will store aqueous ammonia in two (2) stationary, fixed roof storage tanks. The tank capacity will be approximately 16,000 gallons each. The tanks will be enclosed by a containment berm capable of containing the full contents of the tanks as well as incidental rainwater. The approximate berm dimensions are as follows:

- Length 62 ft.
- Width 42 ft.
- Depth 3 ft.
- Capacity = 58,400 gallons

The surface area of the bermed area will be 2604 sq. ft., and the volume will be approximately 58,400 gallons.

An offsite consequence analysis (OCA) was performed for the release scenario involving the complete failure and discharge of the storage tank contents into the secondary containment area. In addition, an alternative release scenario was also evaluated, i.e., failure of the truck unloading hose with a resultant spill to the ground surface.

Table 53-1 shows the meteorological data values used in the modeling scenarios.

**Table 53-1**  
**Meteorological Data for Release Scenarios**

Parameter	Worst Case Met	Alternate Case Met
Wind Speed m/sec	1.5	3
Stability Class	F	D
Relative Humidity %	50	50
Ambient Temperature deg C	37.56 <sup>1</sup>	25

<sup>1</sup> San Jacinto Met Station, Highest Annual Temperature, Western Regional Climatic Center.

A total of two (2) modeling runs were conducted, i.e., tank failure and truck unloading hose failure for the met scenarios listed in Table 53-1.

OCA modeling was conducted using the SLAB model. A complete description of the SLAB model is available in *User's Manual for SLAB: An Atmospheric Dispersion Model for Denser-Than-Air-Releases*, D. E. Ermak, Lawrence Livermore National Laboratory, June 1990. The current version of SLAB contains an internal substance database which includes chemical specific data for ammonia. This data was used in all modeling runs without exception or modification.

Emissions of ammonia from the aqueous ammonia solution were calculated pursuant to the equations and guidance given in *RMP Offsite Consequence Analysis Guidance*, EPA, April 1999. The equation used to predict the emissions is as follows;

$$\text{Eq 1. } \text{QR} = (1.4)(\text{LFA})(\text{A})$$

Where QR = emissions rate, lbs/min

LFA = liquid factor ambient (0.026, 30% solution)

A = diked surface area, sq. ft.

Unadjusted emissions for the tank rupture scenario would be as follows:

$$QR = (1.4)(0.026)(2604)$$

$$\begin{aligned} &= 94.8 \text{ lbs/min} \\ &\text{for a 10 minute release} \\ &= 948 \text{ lbs/10 minutes} \end{aligned}$$

Emissions adjusted for the temperature correction factor of 1.558 for the worst-case scenario would be:

$$\begin{aligned} TCF &= 1.558 \\ 94.8 \text{ lbs/min} \times 1.558 & \\ &= 147.7 \text{ lbs/min} \\ &= 1477 \text{ lbs/10 minutes} \end{aligned}$$

Please note that per *Risk Management Program Guidance for WWTPs, EPA-OSWER, October 1998*, ammonia emissions from the diked area are only calculated for the first 10 minutes of the spill life. EPA states that the release of ammonia from the aqueous solution should only be used for the first 10 minutes after which the ammonia in the pool (diked area) will be more dilute than it was initially and will be evaporating much less rapidly.

Emissions for the truck unloading hose failure scenario would be as follows:

$$\begin{aligned} \text{Hose length} &= 25 \text{ ft.} \\ \text{Hose diameter (ID)} &= 4 \text{ in.} \\ \text{Hose volume} &= 2.2 \text{ cu. ft. or } 16.5 \text{ gallons} \end{aligned}$$

For conservative purposes, the hose volume was doubled to account for truck drainage losses.

$$\begin{aligned} \text{Total product spilled} &= 33 \text{ gallons} \\ @ \sim 7.5 \text{ lbs/gal} & \\ &= 247.5 \text{ lbs spilled to ground surface} \\ \text{Total ammonia spilled} &= 69.3 \text{ lbs. (based on a 28% by wt. solution)} \end{aligned}$$

$$\begin{aligned} \text{Surface area of the spill (m}^2\text{)} &= 33 \text{ gals} \div 2.642 \\ &= 12.5 \text{ m}^2 \end{aligned}$$

For the hose failure scenario, the conservative assumption that all ammonia in the aqueous mixture is lost within the 10-minute release period, i.e., 69.3 lbs.

The specified toxic endpoint (Te) value for ammonia is 0.14 mg/l which is approximately equal to 201 ppm. The Te value is based on a one-hour exposure, therefore, the modeling concentrations at all offsite receptors will be given in terms of one-hour (or 60 minute) exposures. A 28% solution of aqueous ammonia has an approximate vapor pressure of 483 mm/Hg at 70 deg F.

The ammonia storage and unloading area is located at the following UTM coordinates: 484248.303m E, 3733260.169m N. Table 53-2 presents data on the identified sensitive receptors (per the AFC) and the distances from the tank/unloading area. The tank/unloading

area is approximately 38m from the nearest main facility fence line (to the north) and 146m from the nearest outer property line (to the west). Table 53-2 delineates the sensitive receptors within 2 km of the tank area.

**Table 53-2**  
**Sensitive Receptors Within 2 KM of the Ammonia Storage Area.**

Receptor Name	Receptor Type	Direction from IEEC	Distance from IEEC Tank Area
Romoland Headstart	Daycare	NNW	360 m
Romoland Elementary School	School	NNW	360 m

With respect to the assessment of potential impacts associated with an accidental release of ammonia, four offsite "bench mark" exposure levels are typically evaluated, as follows; (1) the lowest concentration posing a risk of lethality, 2000 ppm; (2) the Immediately Dangerous to Life and Health (IDLH) level of 300 ppm; (3) the Emergency Response Planning Guideline (ERPG) level of 200 ppm, which is also the RMP level 1 criterion used by the USEPA and California; and (4) the level considered by CEC staff to be without serious adverse effects on the public for a one-time exposure of 75 ppm (*Preliminary Staff Assessment-Otay Mesa Generating Project, 99-AFC-5, May 2000*).

Table 53-3 delineates a summary of the OCA results.

**Table 53-3**  
**OCA Summary**

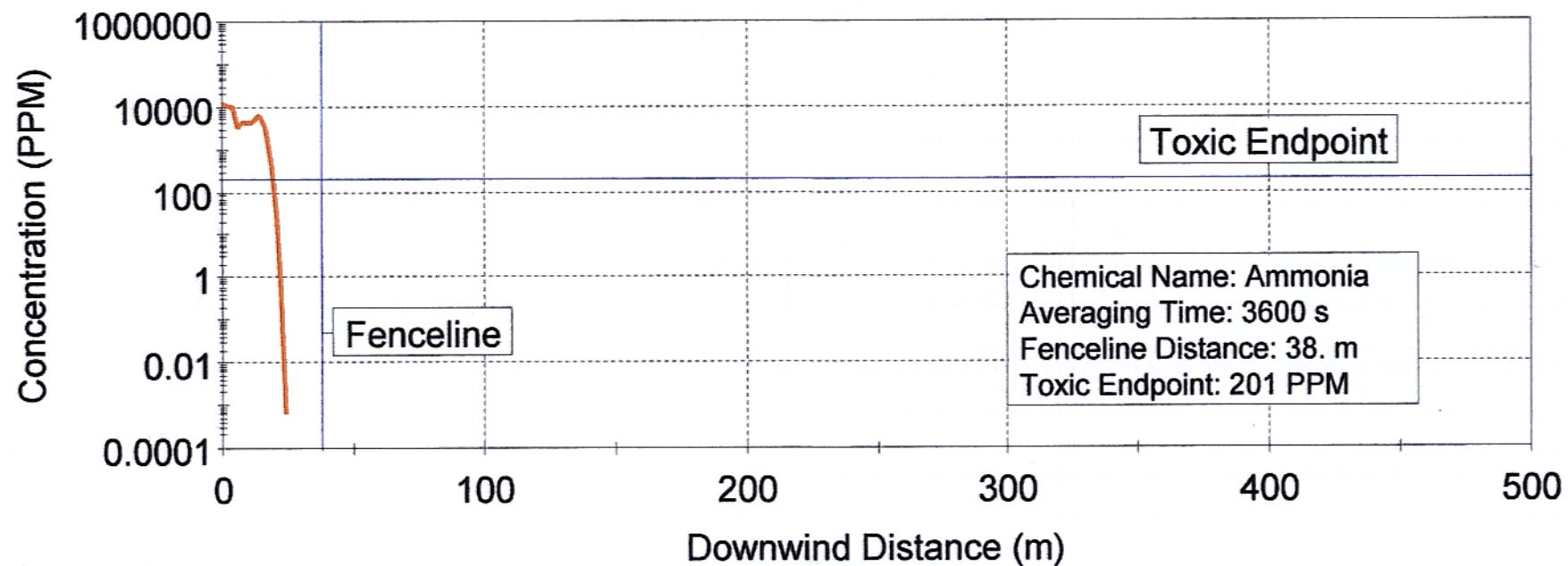
Scenario	Distance to CalARP Te of 201 ppm 1 Hour Exposure	Distance to CEC-LOC of 75 ppm 30 Min Exposure	Sensitive Receptors Impacted
Worst Case	~ 20m	~ 20m	None
Alternate Case	~ 30m	~ 95m	None

Figures 53-1 and 53-2 show the individual scenario results in terms of concentration vs. downwind distance for a 1 hour exposure for the CalARP Te level of 201 ppm. Figures 53-3 and 53-4 show the individual scenario results for the CEC-LOC value of 75 ppm for a 30 minute exposure.

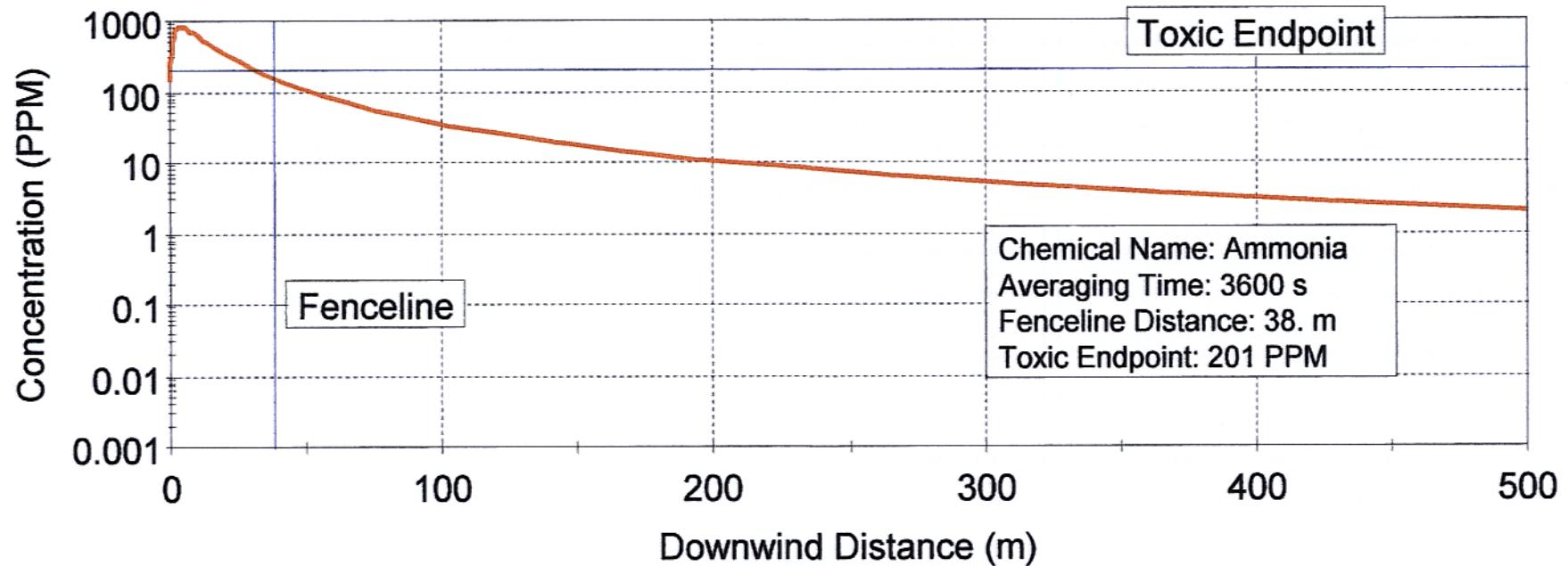
In summary, the conservative OCA analysis for the aqueous ammonia storage tank failure and the truck delivery unloading hose failure scenarios do not show offsite consequences at any offsite receptor or sensitive receptor, i.e., past the main facility fenceline, which is above the federal or CalARP toxic endpoint value. Values above the CEC-LOC of 75 ppm (alternate case only) would occur just past the main site fenceline but well inside the facility property boundary on the north side of the site only.

Haz Mat Attachment 1 contains support weather and climate data as well as the modeling input/output files.

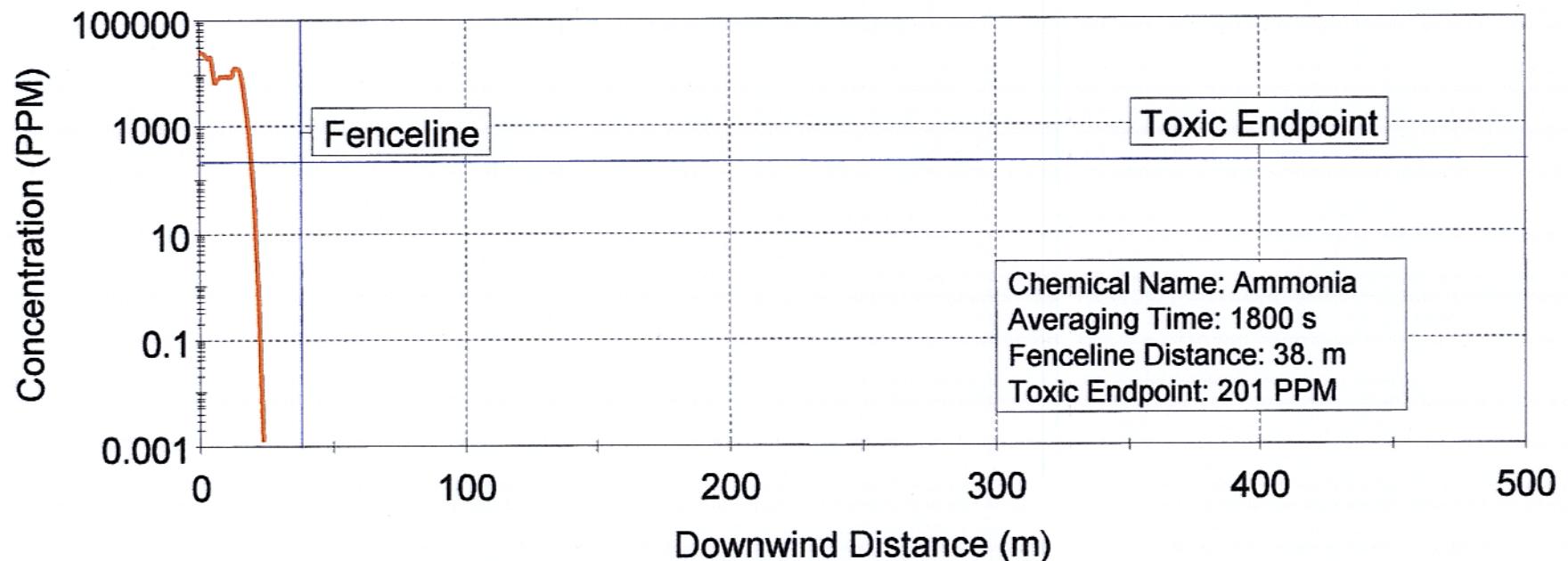
**Figure 53-1**  
**1.5 Meter Centerline Plot**  
**Worst Case-TankFailure**



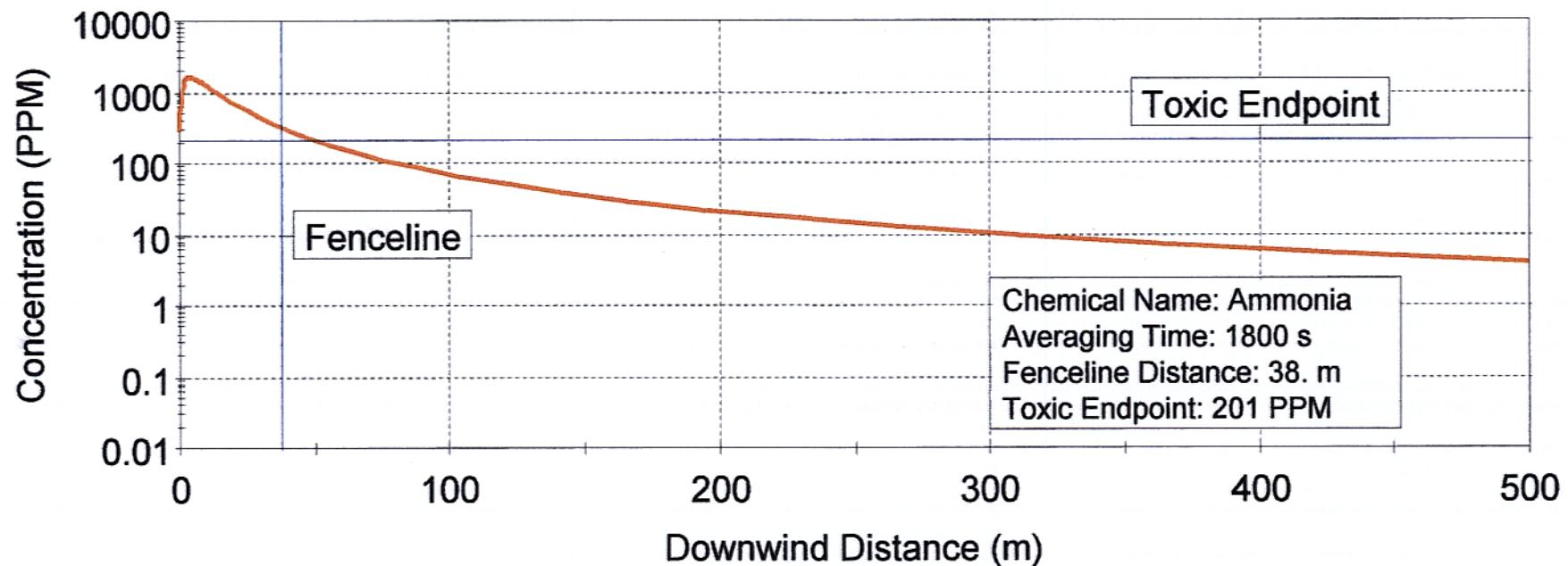
**Figure 53-2**  
**1.5 Meter Centerline Plot**  
**Alternate Case-Unloading Hose Failure**



**Figure 53-3**  
**1.5 Meter Centerline Plot**  
**Worst Case-Tank Failure**



**Figure 53-4**  
**1.5 Meter Centerline Plot**  
**Alternate Case-Unloading Hose Failure**



**Request #54** - Please provide a schematic figure or preliminary design drawings of the aqueous ammonia storage tank and transfer pads, including the measurements of length, width, and depth.

**Response #54** - A schematic figure for the ammonia storage tank containment area is provided in Figure 54-1.

**Request #55** - Please provide toxicity information and/or a material safety data sheet for the substance “non-oxidizing biocide (NALCO 7330)” identified in table 3.4-7.

**Response #55** - A material safety data sheet (MSDS) for NALCO 7330 is provided in Haz Mat Attachment 2.

**Request #56** - Please provide a figure that shows the specific locations of all hazardous materials as listed in Table 3.4-7, including the hydrogen gas cylinder trailer (Figure 3.3-2 is not adequate).

**Response #56** - The storage locations of the hazardous materials listed in Table 3.4-7 are indicated in Table 3.4-6 of the AFC. Table 3.4-6 is repeated below as Table 56-1, however a column has been added tying the storage locations to symbols in Figure 56-1.

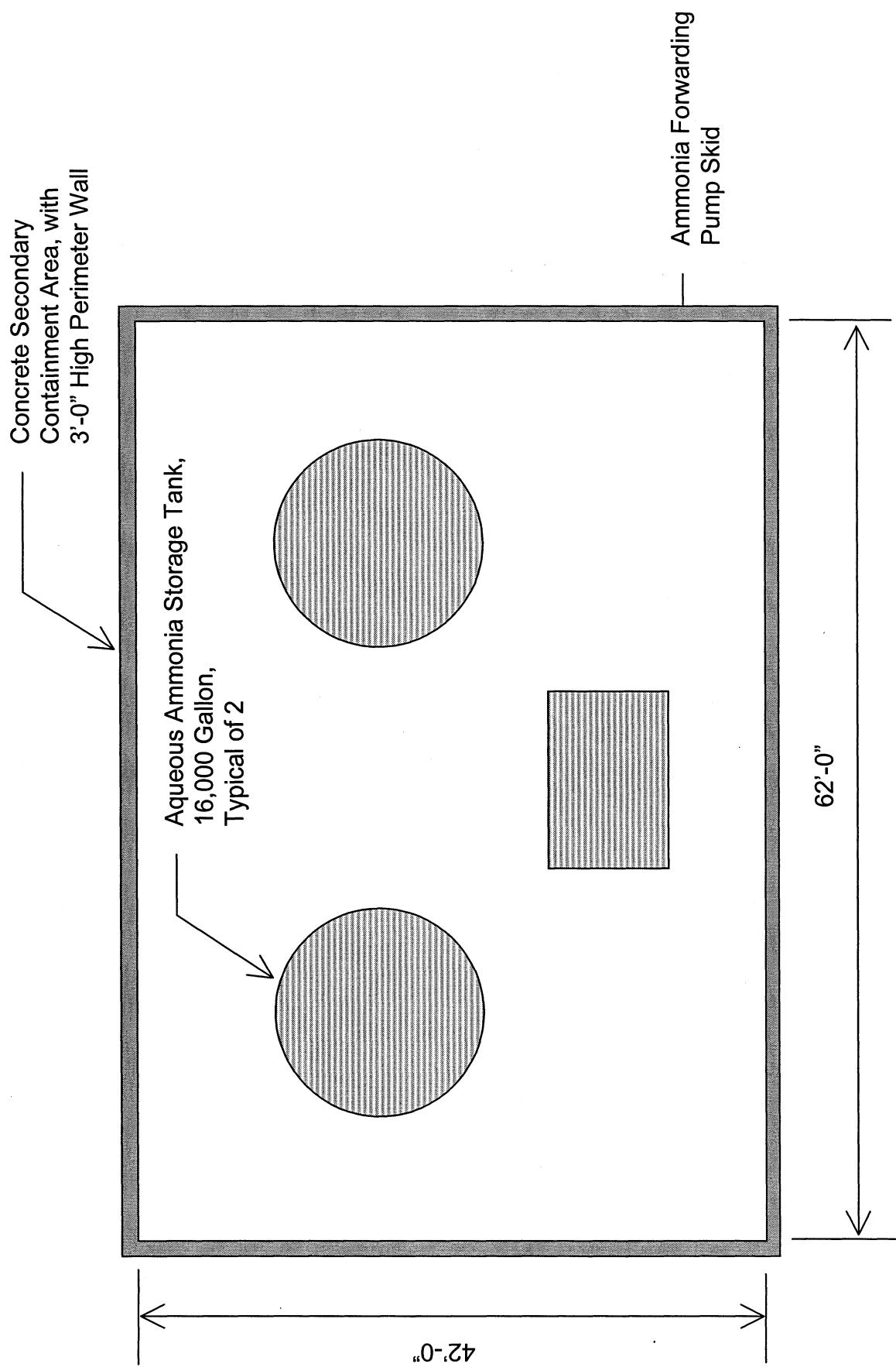


Figure 54-1  
Aqueous Ammonia  
Storage Area Configuration

**Table 56-1**  
**Hazardous Chemical Use and Storage Location – Project Operation**

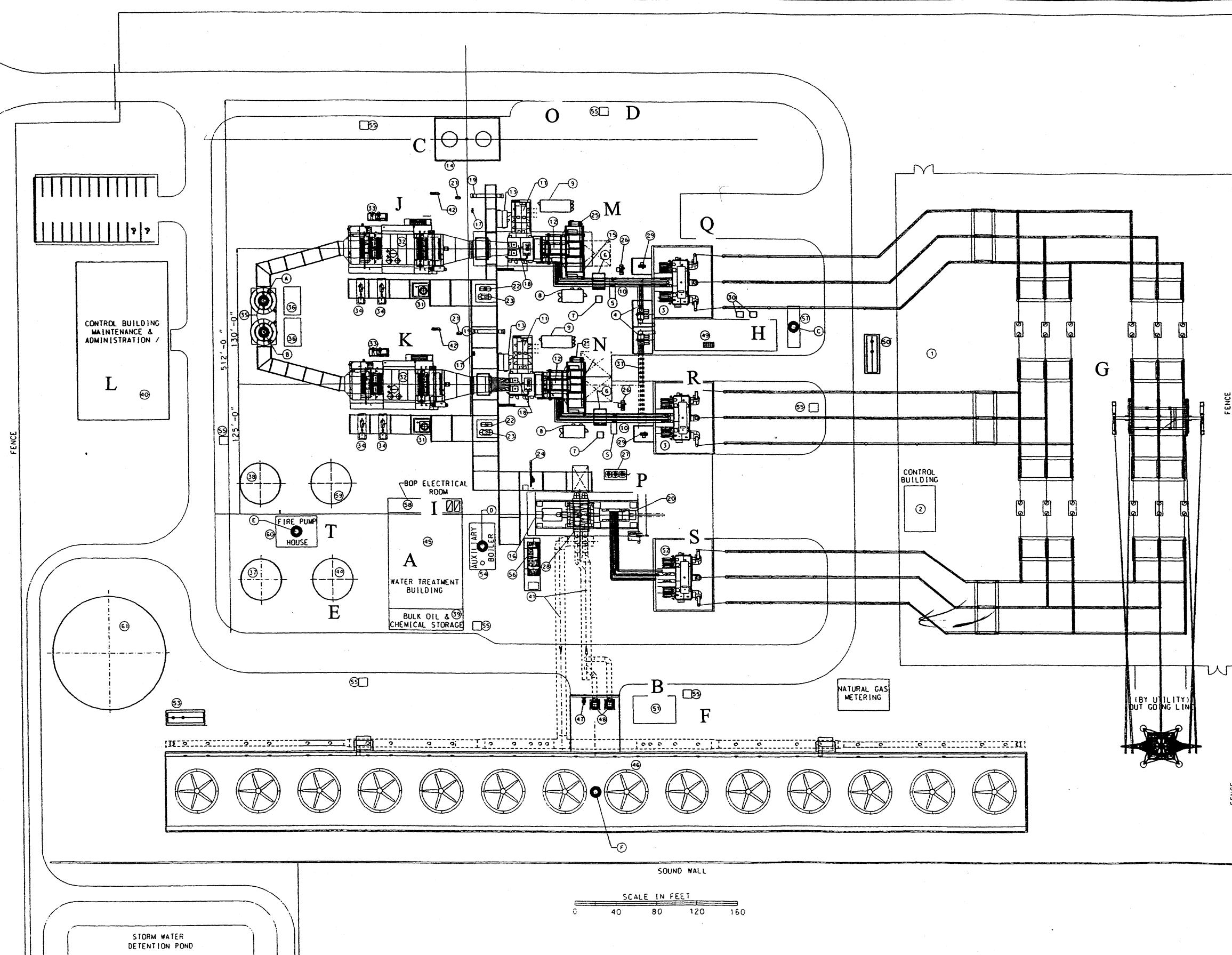
Chemical	Use	Storage Location	Figure 56-1 Key
Aqueous ammonia (28% NH <sub>3</sub> + 72% H <sub>2</sub> O)	Selective catalytic reduction for NO <sub>x</sub> emissions control.	Outdoors, in the ammonia unloading/storage area adjacent to the north HRSG	A
Hydrogen	Combustion turbine and steam turbine generator cooling	Tube trailer adjacent to north combustion turbine	D
Stabilized bromine (e.g. NALCO Stabrex ST70)	Cooling tower biocide and process water pretreatment	Cooling tower chemical building and water treatment building	A, B
Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> ) 93%	Cooling tower pH control, mixed bed demineralizer regeneration (if onsite regeneration is used), pH neutralization	Outdoors near cooling tower and water treatment building	E, F
Sodium bromine	Cooling tower biological control and process water pretreatment	Cooling tower chemical building and water treatment building	A, B
Polyacrylate	Cooling tower scale inhibitor	Cooling tower chemical building	B
Sodium hypochlorite (NaOCl)	Cooling tower biological control and process water pretreatment	Cooling tower chemical building and water treatment building	A, B
Tri-sodium phosphate, di-sodium phosphate, and sodium hexameta phosphate	Boiler water alkalinity control	Water treatment building	A
Neutralizing amines (e.g. NALCO 356 or NALCO TRIACT 1800)	Corrosion control of condensate piping	Water treatment building	A
Oxygen scavenger (e.g. NALCO ELIMIN-OX)	Oxygen scavenger for use in process feedwater to deaerator	Water treatment building	A
Aluminum sulfate, sodium aluminate, or polyaluminum chloride	Coagulant for plant make-up water	Water treatment building	A
Ferric chloride or ferric sulfate	Coagulant for plant make-up water	Water treatment building	A
Coagulant aid polymer (e.g. NALCO NALCOLYTE 8799)	Coagulant for plant make-up water	Water treatment building	A
Phosphonate (e.g. NALCO 7385)	Antiscalant for use in reverse osmosis unit	Water treatment building	A

**Table 56-1  
Hazardous Chemical Use and Storage Location – Project Operation (Continued)**

Chemical	Use	Storage Location	Figure 56-1 Key
Calgon Memclean C	Microfiltration membrane cleaning	Water treatment building	A
Filter aid – cationic, anionic, or non-ionic type polymer solution (e.g. NALCO NALCLEAR 7763)	Process make-up filter aid	Water treatment building	A
Sulfur hexafluoride	High voltage circuit breakers	Contained within equipment	G
Sulfuric acid 29.5%	Batteries	Electrical distribution center battery rooms	H, I
Hydrochloric acid	HRSG chemical cleaning; small quantity kept onsite for maintenance	Brought onsite for HRSG cleaning by cleaning contractor; small quantity stored in water treatment building	A, J, K
Ammonium bifluoride	HRSG chemical cleaning	Brought onsite only for HRSG cleaning by cleaning contractor	J, K
Citric acid	HRSG chemical cleaning and microfiltration membrane cleaning	Brought onsite only for HRSG cleaning by cleaning contractor and also stored in water treatment building	A, J, K
Sodium carbonate (soda ash)	HRSG chemical cleaning	Brought onsite only for HRSG cleaning by cleaning contractor	J, K
Sodium nitrate	HRSG chemical cleaning	Brought onsite only for HRSG cleaning by cleaning contractor	J, K
Hydroxyacetic acid	HRSG chemical cleaning; small quantity kept onsite for maintenance	Brought onsite for HRSG cleaning by cleaning contractor; small quantity stored in water treatment building	A, J, K
Formic acid	HRSG chemical cleaning	Brought onsite only for initial HRSG cleaning by cleaning contractor	J, K
Sodium hydroxide	HRSG treatment, mixed bed demineralizer regeneration (if onsite regeneration is used), pH neutralization	Water treatment building	A
Sodium bisulfite or sodium sulfite	Dechlorination of reverse osmosis feedwater	Water treatment building	A

**Table 56-1**  
**Hazardous Chemical Use and Storage Location – Project Operation (Continued)**

Chemical	Use	Storage Location	Figure 56-1 Key
Non – oxidizing biocide (e.g. NALCO 7330)	Cooling tower biological control	Cooling tower chemical building	B
Antifreeze – ethylene or propylene glycol	Closed loop cooling system corrosion inhibitor	Water treatment building	A
Sodium nitrite	Closed loop cooling system scale inhibitor and HRSG chemical cleaning	Water treatment building and also brought onsite for HRSG cleaning by cleaning contractor	A, J, K
Various laboratory reagents	Laboratory analysis	Water treatment building/laboratory	A
Various cleaning chemicals/detergents	Periodic cleaning of combustion turbines and other equipment and plant facilities	Water treatment building/ laboratory/maintenance shop	A, L
Carbon dioxide	Fire suppression	Bottle racks adjacent to each combustion turbine and steam turbine	M, N
Nitrogen	Blanketing	Trailer adjacent to the north combustion turbine	O
Lubricating oil	Equipment lubrication	Contained within equipment	M, N, P
Hydraulic oil	High pressure combustion turbine starting system, turbine control valve actuators	Contained within equipment	M, N, P
Mineral insulating oil	Transformers/switchyard	Contained within transformers and switches	G, Q, R, S
Diesel fuel	Fire pump engine/vehicles	Near fire pump / contained within equipment	T
Natural gas	Fuel for combustion turbines, auxiliary boiler, and emergency generator	Available on demand via pipeline	N/A



LEGEND	
(1)	ELECTRICAL SUBSTATION AREA
(2)	SWITCHYARD CONTROL BUILDING
(3)	CT MAIN POWER TRANSFORMER
(4)	UNIT AUX. TRANSFORMER
(5)	GROUND DETECTION DISTRIBUTION TRANSFORMER
(6)	GENERATOR CIRCUIT BREAKER
(7)	DC LINK REACTOR (UNDER BREAKER)
(8)	LCI/GEC CONTROL HOUSE
(9)	PACKAGED ELECTRICAL & ELECTRONIC CONTROL CENTER (PECC)
(10)	ISOLATED PHASE BUS DUCT
(11)	ACCESSORY MODULE
(12)	CT GENERATOR
(13)	WATER INJECTION SKID
(14)	AMMONIA STORAGE TANK (AQUEOUS)
(15)	COMBUSTION TURBINE AIR INLET FILTER
(16)	HYDRAULIC CONTROL UNIT
(17)	GAS SCRUBBER
(18)	COMBUSTION TURBINE (CT)
(19)	FUEL GAS HEATER
(20)	ST GENERATOR
(21)	FUEL GAS CONDITIONING DRAINS TANK
(22)	DRAINS TANK
(23)	FALSE START DRAINS TANK
(24)	GLAND STEAM CONDENSOR
(25)	CO2 SKID
(26)	EXCITATION TRANSFORMER
(27)	CONDENSATE PUMPS
(28)	CONDENSE
(29)	CT ISOLATION TRANSFORMER
(30)	4KV/480V TRANSFORMER
(31)	HRSG BLOWDOWN TANK
(32)	HEAT RECOVERY STEAM GENERATOR (HRSG)
(33)	AMMONIA INJECTION SKID
(34)	BOILER FEED PUMPS
(35)	HRSG STACK
(36)	CEMS/MCC BUILDING
(37)	NON-RECLAIMABLE WASTEWATER TANK
(38)	FIREWATER TANK
(39)	OVERHANG FOR BULK OIL & CHEMICAL STORAGE
(40)	ADMIN. & MAINT. BLDG. & CONTROL ROOM
(41)	CIRCULATING WATER PIPING
(42)	DUCT BURNER SKID
(43)	DEMINERALIZED WATER STORAGE TANK
(44)	WATER TREATMENT BUILDING
(45)	COOLING TOWER
(46)	AUXILIARY COOLING WATER PUMPS
(47)	CIRCULATING WATER PUMPS
(48)	MEDIUM VOLTAGE SWITCHGEAR BUILDING
(49)	OIL/WATER SEPARATOR
(50)	COOLING TOWER POWERHOUSE & CHEMICAL TREATMENT/MCC
(51)	STG MAIN POWER TRANSFORMER
(52)	STORM WATER/OIL WATER SEPARATOR
(53)	AUXILIARY BOILER
(54)	HYDRANT
(55)	LUBE OIL EQUIPMENT
(56)	STANDBY GENERATOR
(57)	BOP ELECTRICAL ROOM
(58)	CONDENSATE SURGE TANK
(59)	FIRE PUMP HOUSE
(60)	RECYCLED WATER TANK

UTM COORDINATES		
POINT	NORTH	EAST
A	N3733212.0130	E484186.1268
B	N3733202.8690	E484186.1268
C	N3733194.1951	E484341.7574
D	N3733140.2174	E484250.6960
E	N3733144.4412	E484195.1951
F	N3733068.6856	E484283.5228

CONTROL/ELECTRICAL COMPONENTS KEY	
■	REMOTE I/O MODULES
■	CONTROL PROCESSOR & I/O MODULES
■	480V MOTOR CONTROL CENTER
■	480V UNIT SUBSTATION
■	SKV SWITCHGEAR

Inland Empire Energy Center, LLC  
Inland Empire Energy Center

Figure 56-1  
Hazardous Materials Locations

**Request #57** - Please provide an offsite consequence analysis of blast effects should the hydrogen storage cylinders explode.

**Response #57** - The Code of Federal Regulations 40 (CFR) Part 68 and California Code of Regulations (CCR), Division 2, Chapter 4.5 regulate the potential accidental release of hazardous materials. Article 8, Section 2770.5 includes tables of federally (Tables 1 and 2) and state regulated substances including threshold quantities for regulation under the accidental release prevention program. The threshold quantity for hydrogen ( $H_2$ ) is 10,000 pounds (Table 2). IEEC estimates that the on-site storage for hydrogen is less than 1,000 pounds, well below regulation under the programs above and the threshold quantity for preparation of an OCA. Because the hydrogen used on site is below the threshold quantity, and OCA is not appropriate for IEEC.

**Request #58** - Please identify the agency and the time it will take their personnel to respond to either an on-site hazmat spill or a transportation spill (within five miles of the facility).

**Response #58** - The site is located on the border of three fire station's service areas. In the event of a spill or release of a hazardous material on the site, the 911 dispatcher will determine which fire stations will respond. A Riverside County hazardous material team (HazMat 1) will also be called to respond to any spills or releases at the site. Approximate response times are noted in Table 58-1.

If a transportation spill occurs within five miles of the site, the same actions will be taken as for a spill or release at the site. Response times may be slightly longer for transportation spills as indicated in Table 58-1.

The fire departments will act as first responders in the event of a spill or release, assessing and taking action to contain the spill if possible as well as gathering information about the hazardous material. HazMat 1 will take command upon arrival, mitigate the spill or release, and take appropriate actions to safeguard public health and the environment.

**Table 58-1**  
**Hazardous Material Spill Response Information**

Response Agency	Location	Response Time for On-Site Hazmat Spill (Minutes)	Response Time for Transportation Spill Within 5 Miles of Facility (Minutes)	Phone Number
Fire Department Station 1	210 W San Jacinto Ave. Perris, CA 92570	5	10	911 or 909-940-6900
Fire Department Station 7	27860 Bradley Blvd. Sun City, CA 92586	5	10	911 or 909-679-3413
Fire Department Station 54	25730 Sultanas Rd. Homeland, CA 92548	5	10	911 or 909-926-2433
HazMat 1 Station 76	26020 Wickerd Rd. Menifee, CA 92584	15	20	911 or 909-679-8542

**Hazmat Attachment 1**

**Support Weather And Climate Data**

# SAN JACINTO, CALIFORNIA (047810)

## Period of Record Monthly Climate Summary

Period of Record : 7/ 1/1948 to 5/31/1978

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	65.2	67.6	69.4	75.0	82.0	91.1	99.6	99.4	94.4	84.8	74.1	66.9	80.8
Average Min. Temperature (F)	33.9	36.0	38.3	42.1	47.1	51.1	56.4	56.5	53.2	45.5	38.8	33.9	44.4
Average Total Precipitation (in.)	2.32	1.81	1.84	1.04	0.39	0.05	0.11	0.18	0.45	0.42	1.31	1.47	11.40
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.

Max. Temp.: 98.2% Min. Temp.: 98.2% Precipitation: 98.4% Snowfall: 98.4% Snow Depth: 98.3%

Check Station Metadata or [Metadata graphics](#) for more detail about data completeness.

Western Regional Climate Center, [wrcc@dri.edu](mailto:wrcc@dri.edu)

```
*****
***      BEE-LINE SOFTWARE      ***
***      SLAB VERSION 5.0       ***
**
**      COPYRIGHT (C) 1997-98    **
*****
```

#### SESSION INFORMATION

INPUT DATA FILE NAME : C:\CALPINE\IEEC\NH3TANK.SLB  
OUTPUT LIST FILE NAME : C:\CALPINE\IEEC\NH3TANK.LST

#### problem input

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idspl =      1
ncalc =      1
wms  =  0.017031
cps  =  2093.65
tbp  =  239.70
cmed0 =  0.83
dhe  = 1370837.
cpsl =  4956.39
rhosl =  639.00
spb  = 2132.50
spc  = -32.98
ts   =  310.72
qs   =  1.12
as   =  241.92
tsd  =  600.
qtis =  0.00
hs   =  0.00
tav  = 3600.00
xffm = 2000.00
zp(1) =  1.50
zp(2) =  0.00
zp(3) =  0.00
zp(4) =  0.00
z0   = 0.100000
za   =  10.00
```

ua = 1.50  
ta = 310.72  
rh = 50.00  
stab = 6.00

#### release gas properties

molecular weight of source gas (kg)	- wms = 1.7031E-02
vapor heat capacity, const. p. (j/kg-k)	- cps = 2.0936E+03
temperature of source gas (k)	- ts = 2.3970E+02
density of source gas (kg/m3)	- rhos = 8.6589E-01
boiling point temperature	- tbp = 2.3970E+02
liquid mass fraction	- cmed0= 0.0000E+00
liquid heat capacity (j/kg-k)	- cpsl = 4.9564E+03
heat of vaporization (j/kg)	- dhe = 1.3708E+06
liquid source density (kg/m3)	- rhosl= 6.3900E+02
saturation pressure constant	- spa = 1.0316E+01
saturation pressure constant (k)	- spb = 2.1325E+03
saturation pressure constant (k)	- spc = -3.2980E+01

#### spill characteristics

spill type	- idspl= 1
mass source rate (kg/s)	- qs = 1.1176E+00
continuous source duration (s)	- tsd = 6.0000E+02
continuous source mass (kg)	- qtcs = 6.7056E+02
instantaneous source mass (kg)	- qtis = 0.0000E+00
source area (m2)	- as = 2.4192E+02
vertical vapor velocity (m/s)	- ws = 5.3352E-03
source half width (m)	- bs = 7.7769E+00
source height (m)	- hs = 0.0000E+00
horizontal vapor velocity (m/s)	- us = 0.0000E+00

#### field parameters

concentration averaging time (s)	- tav = 3.6000E+03
mixing layer height (m)	- hmx = 2.6000E+02
maximum downwind distrace (m)	- xffm = 2.0000E+03
concentration measurement height (m)	- zp(1)= 1.5000E+00
	- zp(2)= 0.0000E+00
	- zp(3)= 0.0000E+00
	- zp(4)= 0.0000E+00

### ambient meteorological properties

molecular weight of ambient air (kg)	- wmae = 2.8580E-02
heat capacity of ambient air at const p. (j/kg-k) - cpaa	= 1.0243E+03
density of ambient air (kg/m3)	- rhoa = 1.1209E+00
ambient measurement height (m)	- za = 1.0000E+01
ambient atmospheric pressure (pa=n/m2=j/m3)	- pa = 1.0133E+05
ambient wind speed (m/s)	- ua = 1.5000E+00
ambient temperature (k)	- ta = 3.1072E+02
relative humidity (percent)	- rh = 5.0000E+01
ambient friction velocity (m/s)	- uastr = 6.1310E-02
atmospheric stability class value	- stab = 6.0000E+00
inverse monin-obukhov length (1/m)	- ala = 5.7143E-02
surface roughness height (m)	- z0 = 1.0000E-01

additional parameters

sub-step multiplier	- ncalc =	1
number of calculational sub-steps	- hssm =	3
acceleration of gravity (m/s <sup>2</sup> )	- grav =	9.8067E+00
gas constant (j/mol· K)	- rr =	8.3143E+00
von karman constant	- xk =	4.1000E-01

instantaneous spatially averaged cloud parameters

4.67E+00 0.00E+00 9.28E+00 1.91E+01 7.00E+00 1.63E+01 1.63E+01 3.38E-02 1.12E+00 3.08E+02  
 1.11E-01 1.01E+00  
 6.22E+00 0.00E+00 1.80E+00 1.94E+01 7.01E+00 1.74E+01 1.74E+01 2.87E-02 1.12E+00 3.08E+02  
 7.49E-01 4.47E-01  
 7.78E+00 3.36E-03 2.16E+00 1.95E+01 7.02E+00 1.84E+01 1.84E+01 2.76E-02 1.12E+00 3.08E+02  
 7.13E-01 4.95E-01  
 7.91E+00 9.23E-03 2.22E+00 1.95E+01 7.03E+00 1.86E+01 1.86E+01 2.73E-02 1.12E+00 3.08E+02  
 7.03E-01 5.01E-01  
 8.06E+00 1.77E-02 2.24E+00 1.95E+01 7.03E+00 1.88E+01 1.88E+01 2.70E-02 1.12E+00 3.09E+02  
 7.03E-01 5.04E-01  
 8.24E+00 2.99E-02 2.27E+00 1.95E+01 7.03E+00 1.91E+01 1.91E+01 2.67E-02 1.12E+00 3.09E+02  
 7.03E-01 5.08E-01  
 8.46E+00 4.71E-02 2.30E+00 1.95E+01 7.03E+00 1.94E+01 1.94E+01 2.63E-02 1.12E+00 3.09E+02  
 7.03E-01 5.11E-01  
 8.70E+00 7.12E-02 2.33E+00 1.95E+01 7.03E+00 1.97E+01 1.97E+01 2.59E-02 1.12E+00 3.09E+02  
 7.04E-01 5.16E-01  
 8.99E+00 1.05E-01 2.37E+00 1.96E+01 7.03E+00 2.01E+01 2.01E+01 2.54E-02 1.12E+00 3.09E+02  
 7.04E-01 5.20E-01  
 9.33E+00 1.51E-01 2.42E+00 1.96E+01 7.03E+00 2.06E+01 2.06E+01 2.49E-02 1.12E+00 3.09E+02  
 7.05E-01 5.26E-01  
 9.73E+00 2.14E-01 2.47E+00 1.96E+01 7.03E+00 2.11E+01 2.11E+01 2.43E-02 1.12E+00 3.09E+02  
 7.06E-01 5.31E-01  
 1.02E+01 2.99E-01 2.53E+00 1.96E+01 7.03E+00 2.17E+01 2.17E+01 2.37E-02 1.12E+00 3.09E+02  
 7.07E-01 5.38E-01  
 1.07E+01 4.15E-01 2.59E+00 1.96E+01 7.03E+00 2.25E+01 2.25E+01 2.31E-02 1.12E+00 3.09E+02  
 7.08E-01 5.45E-01  
 1.14E+01 5.72E-01 2.66E+00 1.97E+01 7.03E+00 2.34E+01 2.34E+01 2.24E-02 1.12E+00 3.09E+02  
 7.09E-01 5.53E-01  
 1.21E+01 7.81E-01 2.73E+00 1.97E+01 7.03E+00 2.44E+01 2.44E+01 2.17E-02 1.12E+00 3.09E+02  
 7.11E-01 5.61E-01  
 1.30E+01 1.06E+00 2.81E+00 1.97E+01 7.03E+00 2.56E+01 2.56E+01 2.10E-02 1.12E+00 3.09E+02  
 7.14E-01 5.70E-01  
 1.40E+01 1.43E+00 2.90E+00 1.98E+01 7.03E+00 2.70E+01 2.70E+01 2.02E-02 1.12E+00 3.09E+02  
 7.16E-01 5.79E-01  
 1.52E+01 1.91E+00 2.95E+00 1.98E+01 7.01E+00 2.86E+01 2.86E+01 1.89E-02 1.12E+00 3.09E+02  
 7.54E-01 6.27E-01  
 1.66E+01 2.48E+00 2.95E+00 1.98E+01 6.99E+00 3.05E+01 3.05E+01 1.79E-02 1.12E+00 3.09E+02  
 7.98E-01 6.79E-01  
 1.82E+01 3.18E+00 2.92E+00 1.98E+01 6.97E+00 3.27E+01 3.27E+01 1.71E-02 1.12E+00 3.09E+02  
 8.47E-01 7.35E-01  
 2.01E+01 4.03E+00 2.86E+00 1.98E+01 6.95E+00 3.53E+01 3.53E+01 1.63E-02 1.12E+00 3.09E+02  
 9.01E-01 7.96E-01  
 2.24E+01 5.05E+00 2.80E+00 1.98E+01 6.92E+00 3.84E+01 3.84E+01 1.57E-02 1.12E+00 3.09E+02  
 9.61E-01 8.61E-01  
 2.50E+01 6.27E+00 2.73E+00 1.98E+01 6.90E+00 4.20E+01 4.20E+01 1.51E-02 1.12E+00 3.10E+02  
 1.03E+00 9.31E-01

2.80E+01 7.74E+00 2.65E+00 1.98E+01 6.88E+00 4.62E+01 4.62E+01 1.45E-02 1.12E+00 3.10E+02  
 1.09E+00 1.00E+00  
 3.16E+01 9.48E+00 2.58E+00 1.99E+01 6.85E+00 5.11E+01 5.11E+01 1.39E-02 1.12E+00 3.10E+02  
 1.17E+00 1.08E+00  
 3.58E+01 1.15E+01 2.51E+00 1.99E+01 6.83E+00 5.68E+01 5.68E+01 1.34E-02 1.12E+00 3.10E+02  
 1.24E+00 1.16E+00  
 4.07E+01 1.40E+01 2.45E+00 2.00E+01 6.81E+00 6.35E+01 6.35E+01 1.29E-02 1.12E+00 3.10E+02  
 1.32E+00 1.25E+00  
 4.64E+01 1.69E+01 2.40E+00 2.02E+01 6.79E+00 7.13E+01 7.13E+01 1.23E-02 1.12E+00 3.10E+02  
 1.40E+00 1.33E+00  
 5.31E+01 2.03E+01 2.35E+00 2.03E+01 6.78E+00 8.05E+01 8.05E+01 1.18E-02 1.12E+00 3.10E+02  
 1.48E+00 1.42E+00  
 6.09E+01 2.43E+01 2.31E+00 2.05E+01 6.76E+00 9.12E+01 9.12E+01 1.12E-02 1.12E+00 3.10E+02  
 1.57E+00 1.51E+00  
 7.01E+01 2.90E+01 2.27E+00 2.08E+01 6.75E+00 1.04E+02 1.04E+02 1.07E-02 1.12E+00 3.10E+02  
 1.65E+00 1.60E+00  
 8.08E+01 3.45E+01 2.25E+00 2.11E+01 6.73E+00 1.18E+02 1.18E+02 1.01E-02 1.12E+00 3.10E+02  
 1.74E+00 1.69E+00  
 9.33E+01 4.10E+01 2.23E+00 2.14E+01 6.72E+00 1.36E+02 1.36E+02 9.57E-03 1.12E+00 3.10E+02  
 1.82E+00 1.78E+00  
 1.08E+02 4.85E+01 2.22E+00 2.18E+01 6.71E+00 1.56E+02 1.56E+02 9.01E-03 1.12E+00 3.10E+02  
 1.91E+00 1.87E+00  
 1.25E+02 5.73E+01 2.22E+00 2.24E+01 6.70E+00 1.79E+02 1.79E+02 8.45E-03 1.12E+00 3.10E+02  
 1.99E+00 1.96E+00  
 1.45E+02 6.76E+01 2.22E+00 2.30E+01 6.69E+00 2.07E+02 2.07E+02 7.88E-03 1.12E+00 3.10E+02  
 2.07E+00 2.04E+00  
 1.69E+02 7.96E+01 2.24E+00 2.37E+01 6.68E+00 2.39E+02 2.39E+02 7.32E-03 1.12E+00 3.10E+02  
 2.15E+00 2.13E+00  
 1.96E+02 9.34E+01 2.25E+00 2.45E+01 6.67E+00 2.77E+02 2.77E+02 6.77E-03 1.12E+00 3.10E+02  
 2.23E+00 2.21E+00  
 2.28E+02 1.10E+02 2.28E+00 2.55E+01 6.67E+00 3.21E+02 3.21E+02 6.24E-03 1.12E+00 3.10E+02  
 2.31E+00 2.29E+00  
 2.66E+02 1.28E+02 2.30E+00 2.67E+01 6.66E+00 3.72E+02 3.72E+02 5.73E-03 1.12E+00 3.10E+02  
 2.38E+00 2.37E+00  
 3.10E+02 1.50E+02 2.33E+00 2.80E+01 6.66E+00 4.33E+02 4.32E+02 5.24E-03 1.12E+00 3.10E+02  
 2.45E+00 2.44E+00  
 3.62E+02 1.75E+02 2.35E+00 2.96E+01 6.65E+00 5.03E+02 5.03E+02 4.80E-03 1.12E+00 3.10E+02  
 2.51E+00 2.51E+00  
 4.22E+02 2.04E+02 2.36E+00 3.14E+01 6.65E+00 5.86E+02 5.86E+02 4.39E-03 1.12E+00 3.10E+02  
 2.57E+00 2.57E+00  
 4.92E+02 2.38E+02 2.35E+00 3.36E+01 6.65E+00 6.82E+02 6.82E+02 4.04E-03 1.12E+00 3.10E+02  
 2.62E+00 2.63E+00  
 5.75E+02 2.59E+02 2.33E+00 3.61E+01 6.65E+00 7.95E+02 7.95E+02 3.75E-03 1.12E+00 3.10E+02  
 2.65E+00 2.65E+00  
 6.71E+02 2.59E+02 2.33E+00 3.89E+01 6.65E+00 7.96E+02 7.95E+02 3.47E-03 1.12E+00 3.10E+02  
 2.65E+00 2.65E+00





6.09E+01 6.73E-03 6.73E-03 9.72E-01 2.18E-02 2.18E-02 8.03E-01 0.00E+00 0.00E+00 8.80E-03  
2.86E-02 3.46E-01  
7.01E+01 6.40E-03 6.40E-03 9.72E-01 2.18E-02 2.18E-02 8.50E-01 0.00E+00 0.00E+00 8.03E-03  
3.02E-02 3.43E-01  
8.08E+01 6.06E-03 6.06E-03 9.72E-01 2.18E-02 2.18E-02 8.96E-01 0.00E+00 0.00E+00 7.35E-03  
3.17E-02 3.39E-01  
9.33E+01 5.73E-03 5.73E-03 9.72E-01 2.18E-02 2.18E-02 9.40E-01 0.00E+00 0.00E+00 6.73E-03  
3.33E-02 3.32E-01  
1.08E+02 5.39E-03 5.39E-03 9.73E-01 2.18E-02 2.18E-02 9.82E-01 0.00E+00 0.00E+00 6.16E-03  
3.48E-02 3.24E-01  
1.25E+02 5.05E-03 5.05E-03 9.73E-01 2.18E-02 2.18E-02 1.02E+00 0.00E+00 0.00E+00 5.63E-03  
3.63E-02 3.12E-01  
1.45E+02 4.71E-03 4.71E-03 9.73E-01 2.18E-02 2.18E-02 1.06E+00 0.00E+00 0.00E+00 5.11E-03  
3.78E-02 2.99E-01  
1.69E+02 4.38E-03 4.38E-03 9.74E-01 2.18E-02 2.18E-02 1.09E+00 0.00E+00 0.00E+00 4.61E-03  
3.92E-02 2.82E-01  
1.96E+02 4.05E-03 4.05E-03 9.74E-01 2.18E-02 2.18E-02 1.12E+00 0.00E+00 0.00E+00 4.11E-03  
4.05E-02 2.62E-01  
2.28E+02 3.73E-03 3.73E-03 9.74E-01 2.18E-02 2.18E-02 1.15E+00 0.00E+00 0.00E+00 3.60E-03  
4.17E-02 2.39E-01  
2.66E+02 3.42E-03 3.42E-03 9.75E-01 2.18E-02 2.18E-02 1.17E+00 0.00E+00 0.00E+00 3.08E-03  
4.29E-02 2.11E-01  
3.10E+02 3.13E-03 3.13E-03 9.75E-01 2.18E-02 2.18E-02 1.20E+00 0.00E+00 0.00E+00 2.52E-03  
4.39E-02 1.79E-01  
3.62E+02 2.86E-03 2.86E-03 9.75E-01 2.19E-02 2.19E-02 1.22E+00 0.00E+00 0.00E+00 1.91E-03  
4.48E-02 1.43E-01  
4.22E+02 2.62E-03 2.62E-03 9.76E-01 2.19E-02 2.19E-02 1.24E+00 0.00E+00 0.00E+00 1.24E-03  
4.55E-02 1.02E-01  
4.92E+02 2.41E-03 2.41E-03 9.76E-01 2.19E-02 2.19E-02 1.28E+00 0.00E+00 0.00E+00 4.78E-04  
4.60E-02 6.41E-02  
5.75E+02 2.24E-03 2.24E-03 9.76E-01 2.19E-02 2.19E-02 1.33E+00 0.00E+00 0.00E+00 2.57E-05  
4.60E-02 5.52E-02  
6.71E+02 2.07E-03 2.07E-03 9.76E-01 2.19E-02 2.19E-02 1.38E+00 0.00E+00 0.00E+00 2.58E-05  
4.54E-02 1.03E-02  
7.84E+02 1.90E-03 1.90E-03 9.76E-01 2.19E-02 2.19E-02 1.42E+00 0.00E+00 0.00E+00 2.58E-05  
4.47E-02 1.03E-02  
9.16E+02 1.74E-03 1.74E-03 9.76E-01 2.19E-02 2.19E-02 1.47E+00 0.00E+00 0.00E+00 2.58E-05  
4.39E-02 1.03E-02  
1.07E+03 1.59E-03 1.59E-03 9.77E-01 2.19E-02 2.19E-02 1.51E+00 0.00E+00 0.00E+00 2.58E-05  
4.31E-02 1.02E-02  
1.25E+03 1.44E-03 1.44E-03 9.77E-01 2.19E-02 2.19E-02 1.55E+00 0.00E+00 0.00E+00 2.59E-05  
4.22E-02 1.02E-02  
1.46E+03 1.30E-03 1.30E-03 9.77E-01 2.19E-02 2.19E-02 1.59E+00 0.00E+00 0.00E+00 2.59E-05  
4.12E-02 1.02E-02  
1.71E+03 1.17E-03 1.17E-03 9.77E-01 2.19E-02 2.19E-02 1.62E+00 0.00E+00 0.00E+00 2.60E-05  
4.01E-02 1.02E-02

2.00E+03 1.05E-03 1.05E-03 9.77E-01 2.19E-02 2.19E-02 1.65E+00 0.00E+00 0.00E+00 2.60E-05  
 3.89E-02 1.02E-02  
 1

time averaged (tav = 3600. s) volume concentration: concentration contour parameters

$$c(x,y,z,t) = cc(x) * (\text{erf}(xa)-\text{erf}(xb)) * (\text{erf}(ya)-\text{erf}(yb)) * (\exp(-za*za)+\exp(-zb*zb))$$

$c(x,y,z,t)$  = concentration (volume fraction) at  $(x,y,z,t)$

$x$  = downwind distance (m)

$y$  = crosswind horizontal distance (m)

$z$  = height (m)

$t$  = time (s)

erf = error function

$$xa = (x-xc+bx)/(sr2*betax)$$

$$xb = (x-xc-bx)/(sr2*betax)$$

$$ya = (y+b)/(sr2*betac)$$

$$yb = (y-b)/(sr2*betac)$$

exp = exponential function

$$za = (z-zc)/(sr2*sig)$$

$$zb = (z+zc)/(sr2*sig)$$

$$sr2 = \sqrt{2.0}$$

x	cc(x)	b(x)	betac(x)	zc(x)	sig(x)	t	xc(t)	bx(t)	betax(t)
-7.78E+00	0.00E+00	7.00E+00	1.96E+00	0.00E+00	0.00E+00	2.59E+01	0.00E+00	7.78E+00	
6.35E-02									
-6.22E+00	5.59E-03	7.00E+00	2.04E+00	0.00E+00	6.86E-01	2.95E+01	7.78E-01	8.84E+00	7.22E-02
-4.67E+00	8.25E-03	7.00E+00	2.14E+00	0.00E+00	9.04E-01	3.30E+01	1.56E+00	9.91E+00	8.09E-02
-3.11E+00	1.03E-02	7.00E+00	2.32E+00	0.00E+00	1.20E+00	4.68E+01	2.33E+00	1.10E+01	8.96E-02
-1.56E+00	1.21E-02	7.00E+00	2.69E+00	0.00E+00	1.82E+00	6.06E+01	3.11E+00	1.20E+01	9.83E-02
9.54E-07	1.32E-02	7.00E+00	5.13E+00	0.00E+00	3.10E+00	7.15E+01	3.89E+00	1.31E+01	1.07E-01
1.56E+00	1.43E-02	7.00E+00	5.44E+00	0.00E+00	2.01E+00	8.24E+01	4.67E+00	1.42E+01	1.16E-01
3.11E+00	1.53E-02	7.00E+00	8.85E+00	0.00E+00	2.33E+00	8.46E+01	5.44E+00	1.52E+01	1.24E-01
4.67E+00	1.60E-02	7.00E+00	1.03E+01	0.00E+00	5.36E+00	8.68E+01	6.22E+00	1.63E+01	1.33E-01
6.22E+00	1.37E-02	7.01E+00	1.04E+01	0.00E+00	1.04E+00	8.88E+01	7.00E+00	1.74E+01	1.42E-01

7.78E+00	1.33E-02	7.02E+00	1.05E+01	3.36E-03	1.25E+00	9.09E+01	7.78E+00	1.84E+01	1.51E-01
7.91E+00	1.32E-02	7.03E+00	1.05E+01	9.23E-03	1.27E+00	9.12E+01	7.91E+00	1.86E+01	1.52E-01
8.06E+00	1.31E-02	7.03E+00	1.05E+01	1.77E-02	1.28E+00	9.17E+01	8.06E+00	1.88E+01	1.54E-01
8.24E+00	1.30E-02	7.03E+00	1.05E+01	2.99E-02	1.29E+00	9.22E+01	8.24E+00	1.91E+01	1.56E-01
8.46E+00	1.29E-02	7.03E+00	1.05E+01	4.71E-02	1.30E+00	9.28E+01	8.46E+00	1.94E+01	1.58E-01
8.70E+00	1.29E-02	7.03E+00	1.06E+01	7.12E-02	1.31E+00	9.35E+01	8.70E+00	1.97E+01	1.61E-01
8.99E+00	1.28E-02	7.03E+00	1.06E+01	1.05E-01	1.31E+00	9.43E+01	8.99E+00	2.01E+01	1.64E-01
9.33E+00	1.28E-02	7.03E+00	1.06E+01	1.51E-01	1.31E+00	9.53E+01	9.33E+00	2.06E+01	1.68E-01
9.73E+00	1.29E-02	7.03E+00	1.06E+01	2.14E-01	1.30E+00	9.64E+01	9.73E+00	2.11E+01	1.72E-01
1.02E+01	1.30E-02	7.03E+00	1.06E+01	2.99E-01	1.29E+00	9.77E+01	1.02E+01	2.17E+01	1.78E-01
1.07E+01	1.33E-02	7.03E+00	1.06E+01	4.15E-01	1.26E+00	9.93E+01	1.07E+01	2.25E+01	1.84E-01
1.14E+01	1.39E-02	7.03E+00	1.06E+01	5.72E-01	1.20E+00	1.01E+02	1.14E+01	2.34E+01	1.91E-01
1.21E+01	1.48E-02	7.03E+00	1.07E+01	7.81E-01	1.13E+00	1.03E+02	1.21E+01	2.44E+01	1.99E-01
1.30E+01	1.64E-02	7.03E+00	1.07E+01	1.06E+00	1.01E+00	1.06E+02	1.30E+01	2.56E+01	2.09E-01
1.40E+01	1.95E-02	7.03E+00	1.07E+01	1.43E+00	8.49E-01	1.08E+02	1.40E+01	2.70E+01	2.20E-01
1.52E+01	1.85E-02	7.01E+00	1.07E+01	1.91E+00	8.52E-01	1.12E+02	1.52E+01	2.86E+01	2.33E-01
1.66E+01	1.76E-02	6.99E+00	1.07E+01	2.48E+00	8.52E-01	1.15E+02	1.66E+01	3.05E+01	2.49E-01
1.82E+01	1.68E-02	6.97E+00	1.07E+01	3.18E+00	8.42E-01	1.19E+02	1.82E+01	3.27E+01	2.67E-01
2.01E+01	1.61E-02	6.95E+00	1.07E+01	4.03E+00	8.27E-01	1.24E+02	2.01E+01	3.53E+01	2.89E-01
2.24E+01	1.56E-02	6.92E+00	1.08E+01	5.05E+00	8.07E-01	1.28E+02	2.24E+01	3.84E+01	3.14E-01
2.50E+01	1.50E-02	6.90E+00	1.08E+01	6.27E+00	7.87E-01	1.34E+02	2.50E+01	4.20E+01	3.43E-01
2.80E+01	1.46E-02	6.88E+00	1.08E+01	7.74E+00	7.66E-01	1.39E+02	2.80E+01	4.62E+01	3.77E-01
3.16E+01	1.41E-02	6.85E+00	1.09E+01	9.48E+00	7.45E-01	1.46E+02	3.16E+01	5.11E+01	4.17E-01

3.58E+01 1.37E-02 6.83E+00 1.10E+01 1.15E+01 7.25E-01 01	1.53E+02 3.58E+01 5.68E+01 4.64E- 01
4.07E+01 1.33E-02 6.81E+00 1.11E+01 1.40E+01 7.08E-01 01	1.60E+02 4.07E+01 6.35E+01 5.18E- 01
4.64E+01 1.29E-02 6.79E+00 1.12E+01 1.69E+01 6.92E-01 01	1.69E+02 4.64E+01 7.13E+01 5.82E- 01
5.31E+01 1.25E-02 6.78E+00 1.14E+01 2.03E+01 6.78E-01 01	1.78E+02 5.31E+01 8.05E+01 6.57E- 01
6.09E+01 1.21E-02 6.76E+00 1.16E+01 2.43E+01 6.66E-01 01	1.88E+02 6.09E+01 9.12E+01 7.45E- 01
7.01E+01 1.18E-02 6.75E+00 1.18E+01 2.90E+01 6.57E-01 01	2.00E+02 7.01E+01 1.04E+02 8.47E- 01
8.08E+01 1.15E-02 6.73E+00 1.21E+01 3.45E+01 6.49E-01 01	2.12E+02 8.08E+01 1.18E+02 9.67E- 01
9.33E+01 1.11E-02 6.72E+00 1.25E+01 4.10E+01 6.44E-01 1.11E+00	2.26E+02 9.33E+01 1.36E+02
1.08E+02 1.09E-02 6.71E+00 1.29E+01 4.85E+01 6.41E-01 1.27E+00	2.42E+02 1.08E+02 1.56E+02
1.25E+02 1.06E-02 6.70E+00 1.35E+01 5.73E+01 6.41E-01 1.46E+00	2.60E+02 1.25E+02 1.79E+02
1.45E+02 1.04E-02 6.69E+00 1.42E+01 6.76E+01 6.42E-01 1.69E+00	2.79E+02 1.45E+02 2.07E+02
1.69E+02 1.02E-02 6.68E+00 1.50E+01 7.96E+01 6.46E-01 1.95E+00	3.02E+02 1.69E+02 2.39E+02
1.96E+02 1.00E-02 6.67E+00 1.60E+01 9.34E+01 6.51E-01 2.26E+00	3.27E+02 1.96E+02 2.77E+02
2.28E+02 9.90E-03 6.67E+00 1.72E+01 1.10E+02 6.57E-01 2.62E+00	3.55E+02 2.28E+02 3.21E+02
2.66E+02 9.83E-03 6.66E+00 1.87E+01 1.28E+02 6.64E-01 3.04E+00	3.87E+02 2.66E+02 3.72E+02
3.10E+02 9.80E-03 6.66E+00 2.04E+01 1.50E+02 6.71E-01 3.53E+00	4.24E+02 3.10E+02 4.32E+02
3.62E+02 9.84E-03 6.65E+00 2.25E+01 1.75E+02 6.77E-01 4.11E+00	4.65E+02 3.62E+02 5.03E+02
4.22E+02 9.96E-03 6.65E+00 2.49E+01 2.04E+02 6.80E-01 4.78E+00	5.13E+02 4.22E+02 5.86E+02
4.92E+02 1.02E-02 6.65E+00 2.77E+01 2.38E+02 6.78E-01 5.57E+00	5.67E+02 4.92E+02 6.82E+02
5.75E+02 1.06E-02 6.65E+00 3.11E+01 2.59E+02 6.73E-01 6.49E+00	6.29E+02 5.75E+02 7.95E+02
6.71E+02 1.10E-02 6.65E+00 3.50E+01 2.59E+02 6.74E-01 2.16E+01	6.36E+02 6.71E+02 7.95E+02
7.84E+02 1.14E-02 6.65E+00 3.95E+01 2.59E+02 6.74E-01 2.94E+01	6.79E+02 7.84E+02 7.95E+02
9.16E+02 1.18E-02 6.65E+00 4.47E+01 2.59E+02 6.75E-01 3.66E+01	7.29E+02 9.16E+02 7.95E+02

1.07E+03	1.22E-02	6.65E+00	5.07E+01	2.59E+02	6.75E-01	7.87E+02	1.07E+03	7.95E+02
4.35E+01								
1.25E+03	1.26E-02	6.65E+00	5.76E+01	2.59E+02	6.76E-01	8.55E+02	1.25E+03	7.95E+02
5.03E+01								
1.46E+03	1.30E-02	6.65E+00	6.55E+01	2.59E+02	6.77E-01	9.35E+02	1.46E+03	7.95E+02
5.73E+01								
1.71E+03	1.33E-02	6.65E+00	7.45E+01	2.59E+02	6.79E-01	1.03E+03	1.71E+03	7.95E+02
6.46E+01								
2.00E+03	1.36E-02	6.65E+00	8.47E+01	2.59E+02	6.80E-01	1.14E+03	2.00E+03	7.95E+02
7.21E+01								
1								

time averaged (tav = 3600. s) volume concentration: concentration in the z = 1.50 plane.

downwind distance x (m)	time of max conc (s)	cloud duration bbc (m)	effective half width bbc (m)	average concentration (volume fraction) at (x,y,z) y/bbc= 0.0 0.5 1.0 1.5 2.0 2.5
-7.78E+00	3.04E+02	6.00E+02	7.78E+00	0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0.00E+00				
-6.22E+00	3.03E+02	6.00E+02	7.84E+00	6.83E-04 6.39E-04 2.32E-04 6.72E-06 7.21E-09
0.00E+00				
-4.67E+00	3.02E+02	6.00E+02	7.92E+00	2.78E-03 2.56E-03 9.26E-04 3.14E-05 5.06E-08
0.00E+00				
-3.11E+00	3.02E+02	6.00E+02	8.07E+00	6.25E-03 5.64E-03 2.02E-03 8.63E-05 2.49E-07
0.00E+00				
-1.56E+00	3.01E+02	6.00E+02	8.41E+00	1.14E-02 9.77E-03 3.45E-03 2.11E-04 1.49E-06
1.03E-09				
9.54E-07	3.00E+02	6.00E+02	1.13E+01	1.29E-02 9.33E-03 3.13E-03 4.07E-04 1.81E-05
2.62E-07				
1.56E+00	3.01E+02	6.00E+02	1.17E+01	1.15E-02 8.25E-03 2.76E-03 3.68E-04 1.76E-05
2.87E-07				
3.11E+00	3.02E+02	6.00E+02	1.69E+01	9.48E-03 6.56E-03 2.15E-03 3.21E-04 2.11E-05
5.98E-07				
4.67E+00	3.02E+02	6.00E+02	1.91E+01	1.03E-02 7.12E-03 2.32E-03 3.51E-04 2.40E-05
7.29E-07				
6.22E+00	3.03E+02	6.00E+02	1.94E+01	3.19E-03 2.20E-03 7.18E-04 1.09E-04 7.44E-06
2.27E-07				
7.78E+00	3.04E+02	6.00E+02	1.95E+01	4.25E-03 2.93E-03 9.56E-04 1.45E-04 9.93E-06
3.04E-07				
7.91E+00	3.04E+02	6.00E+02	1.95E+01	4.35E-03 3.00E-03 9.79E-04 1.48E-04 1.02E-05
3.11E-07				
8.06E+00	3.04E+02	6.00E+02	1.95E+01	4.36E-03 3.01E-03 9.81E-04 1.48E-04 1.02E-05
3.12E-07				
8.24E+00	3.04E+02	6.00E+02	1.96E+01	4.37E-03 3.01E-03 9.83E-04 1.49E-04 1.02E-05
3.12E-07				





2.00E+03	1.14E+03	6.07E+02	1.47E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00								
1								

time averaged (tav = 3600. s) volume concentration: maximum concentration (volume fraction) along centerline.

downwind distance x (m)	height z (m)	maximum concentration c(x,0,z) (s)	time of max conc (s)	cloud duration (s)
-7.78E+00	0.00E+00	0.00E+00	3.04E+02	6.00E+02
-6.22E+00	0.00E+00	7.44E-03	3.03E+02	6.00E+02
-4.67E+00	0.00E+00	1.10E-02	3.02E+02	6.00E+02
-3.11E+00	0.00E+00	1.37E-02	3.02E+02	6.00E+02
-1.56E+00	0.00E+00	1.59E-02	3.01E+02	6.00E+02
9.54E-07	0.00E+00	1.45E-02	3.00E+02	6.00E+02
1.56E+00	0.00E+00	1.52E-02	3.01E+02	6.00E+02
3.11E+00	0.00E+00	1.17E-02	3.02E+02	6.00E+02
4.67E+00	0.00E+00	1.07E-02	3.02E+02	6.00E+02
6.22E+00	0.00E+00	9.09E-03	3.03E+02	6.00E+02
7.78E+00	0.00E+00	8.76E-03	3.04E+02	6.00E+02
7.91E+00	0.00E+00	8.70E-03	3.04E+02	6.00E+02
8.06E+00	0.00E+00	8.64E-03	3.04E+02	6.00E+02
8.24E+00	0.00E+00	8.57E-03	3.04E+02	6.00E+02
8.46E+00	0.00E+00	8.51E-03	3.04E+02	6.00E+02
8.70E+00	0.00E+00	8.45E-03	3.05E+02	6.00E+02
8.99E+00	0.00E+00	8.39E-03	3.05E+02	6.00E+02
9.33E+00	0.00E+00	8.35E-03	3.05E+02	6.00E+02
9.73E+00	0.00E+00	8.33E-03	3.05E+02	6.00E+02
1.02E+01	0.00E+00	8.30E-03	3.05E+02	6.00E+02
1.07E+01	0.00E+00	8.25E-03	3.06E+02	6.00E+02
1.14E+01	0.00E+00	8.09E-03	3.06E+02	6.00E+02
1.21E+01	0.00E+00	7.58E-03	3.06E+02	6.00E+02
1.30E+01	5.31E-01	6.20E-03	3.07E+02	6.00E+02
1.40E+01	1.42E+00	6.35E-03	3.07E+02	6.00E+02
1.52E+01	1.91E+00	5.99E-03	3.08E+02	6.00E+02
1.66E+01	2.48E+00	5.66E-03	3.09E+02	6.00E+02
1.82E+01	3.18E+00	5.39E-03	3.10E+02	6.00E+02
2.01E+01	4.03E+00	5.16E-03	3.11E+02	6.00E+02
2.24E+01	5.05E+00	4.95E-03	3.12E+02	6.00E+02
2.50E+01	6.27E+00	4.75E-03	3.13E+02	6.00E+02
2.80E+01	7.74E+00	4.56E-03	3.15E+02	6.00E+02
3.16E+01	9.48E+00	4.38E-03	3.16E+02	6.00E+02
3.58E+01	1.15E+01	4.20E-03	3.19E+02	6.00E+02
4.07E+01	1.40E+01	4.02E-03	3.21E+02	6.00E+02
4.64E+01	1.69E+01	3.84E-03	3.24E+02	6.00E+02

5.31E+01	2.03E+01	3.66E-03	3.28E+02	6.00E+02
6.09E+01	2.43E+01	3.47E-03	3.32E+02	6.00E+02
7.01E+01	2.90E+01	3.28E-03	3.37E+02	6.00E+02
8.08E+01	3.45E+01	3.08E-03	3.42E+02	6.00E+02
9.33E+01	4.10E+01	2.88E-03	3.49E+02	6.00E+02
1.08E+02	4.85E+01	2.67E-03	3.56E+02	6.00E+02
1.25E+02	5.73E+01	2.47E-03	3.65E+02	6.00E+02
1.45E+02	6.76E+01	2.26E-03	3.76E+02	6.00E+02
1.69E+02	7.96E+01	2.05E-03	3.88E+02	6.00E+02
1.96E+02	9.34E+01	1.85E-03	4.02E+02	6.00E+02
2.28E+02	1.10E+02	1.65E-03	4.19E+02	6.00E+02
2.66E+02	1.28E+02	1.47E-03	4.39E+02	6.00E+02
3.10E+02	1.50E+02	1.30E-03	4.62E+02	6.00E+02
3.62E+02	1.75E+02	1.14E-03	4.89E+02	6.00E+02
4.22E+02	2.04E+02	1.01E-03	5.20E+02	6.00E+02
4.92E+02	2.38E+02	8.90E-04	5.57E+02	6.00E+02
5.75E+02	2.59E+02	7.94E-04	6.00E+02	6.00E+02
6.71E+02	2.59E+02	7.06E-04	6.36E+02	6.01E+02
7.84E+02	2.59E+02	6.26E-04	6.79E+02	6.01E+02
9.16E+02	2.59E+02	5.53E-04	7.29E+02	6.02E+02
1.07E+03	2.59E+02	4.87E-04	7.87E+02	6.02E+02
1.25E+03	2.59E+02	4.29E-04	8.55E+02	6.03E+02
1.46E+03	2.59E+02	3.77E-04	9.35E+02	6.04E+02
1.71E+03	2.59E+02	3.31E-04	1.03E+03	6.06E+02
2.00E+03	2.59E+02	2.90E-04	1.14E+03	6.07E+02

```
*****
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***      SLAB VERSION 5.0      ***
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*****
```

#### SESSION INFORMATION

INPUT DATA FILE NAME : C:\CALPINE\IEEC\NH3TANK.SLB  
OUTPUT LIST FILE NAME : C:\CALPINE\IEEC\NH3TANK.LST

problem input

```
idspl =      1
ncalc =      1
wms  =  0.017031
cps  =  2093.65
tbp  =  239.70
cmed0 =  0.83
dhe  = 1370837.
cpsl =  4956.39
rhosl =  639.00
spb  = 2132.50
spc  = -32.98
ts   =  310.72
qs   =  1.12
as   = 241.92
tsd  =  600.
qtis =  0.00
hs   =  0.00
tav  = 1800.00
xffm = 2000.00
zp(1)=  1.50
zp(2)=  0.00
zp(3)=  0.00
zp(4)=  0.00
z0   = 0.100000
za   =  10.00
```

ua = 1.50  
ta = 310.72  
rh = 50.00  
stab = 6.00

#### release gas properties

molecular weight of source gas (kg)	- wms = 1.7031E-02
vapor heat capacity, const. p. (j/kg-k)	- cps = 2.0936E+03
temperature of source gas (k)	- ts = 2.3970E+02
density of source gas (kg/m3)	- rhos = 8.6589E-01
boiling point temperature	- tbp = 2.3970E+02
liquid mass fraction	- cmed0= 0.0000E+00
liquid heat capacity (j/kg-k)	- cpsl = 4.9564E+03
heat of vaporization (j/kg)	- dhe = 1.3708E+06
liquid source density (kg/m3)	- rho1= 6.3900E+02
saturation pressure constant	- spa = 1.0316E+01
saturation pressure constant (k)	- spb = 2.1325E+03
saturation pressure constant (k)	- spc = -3.2980E+01

#### spill characteristics

spill type	- idspl= 1
mass source rate (kg/s)	- qs = 1.1176E+00
continuous source duration (s)	- tsd = 6.0000E+02
continuous source mass (kg)	- qtcs = 6.7056E+02
instantaneous source mass (kg)	- qtis = 0.0000E+00
source area (m2)	- as = 2.4192E+02
vertical vapor velocity (m/s)	- ws = 5.3352E-03
source half width (m)	- bs = 7.7769E+00
source height (m)	- hs = 0.0000E+00
horizontal vapor velocity (m/s)	- us = 0.0000E+00

#### field parameters

concentration averaging time (s)	- tav = 1.8000E+03
mixing layer height (m)	- hmx = 2.6000E+02
maximum downwind distrace (m)	- xffm = 2.0000E+03
concentration measurement height (m)	- zp(1)= 1.5000E+00
	- zp(2)= 0.0000E+00
	- zp(3)= 0.0000E+00
	- zp(4)= 0.0000E+00

## ambient meteorological properties

molecular weight of ambient air (kg) - wmae = 2.8580E-02  
 heat capacity of ambient air at const p. (j/kg-k)- cpaa = 1.0243E+03  
 density of ambient air (kg/m3) - rhoa = 1.1209E+00  
 ambient measurement height (m) - za = 1.0000E+01  
 ambient atmospheric pressure (pa=n/m2=j/m3) - pa = 1.0133E+05  
 ambient wind speed (m/s) - ua = 1.5000E+00  
 ambient temperature (k) - ta = 3.1072E+02  
 relative humidity (percent) - rh = 5.0000E+01  
 ambient friction velocity (m/s) - uastr = 6.1310E-02  
 atmospheric stability class value - stab = 6.0000E+00  
 inverse monin-obukhov length (1/m) - ala = 5.7143E-02  
 surface roughness height (m) - z0 = 1.0000E-01

additional parameters

```

sub-step multiplier           - ncalc =      1
number of calculational sub-steps - nssm =      3
acceleration of gravity (m/s2) - grav = 9.8067E+00
gas constant (j/mol- k)       - rr   = 8.3143E+00
von karman constant          - xk   = 4.1000E-01
1

```

## instantaneous spatially averaged cloud parameters

4.67E+00 0.00E+00 9.28E+00 1.91E+01 7.00E+00 1.63E+01 1.63E+01 3.38E-02 1.12E+00 3.08E+02  
 1.11E-01 1.01E+00  
 6.22E+00 0.00E+00 1.80E+00 1.94E+01 7.01E+00 1.74E+01 1.74E+01 2.87E-02 1.12E+00 3.08E+02  
 7.49E-01 4.47E-01  
 7.78E+00 3.36E-03 2.16E+00 1.95E+01 7.02E+00 1.84E+01 1.84E+01 2.76E-02 1.12E+00 3.08E+02  
 7.13E-01 4.95E-01  
 7.91E+00 9.23E-03 2.22E+00 1.95E+01 7.03E+00 1.86E+01 1.86E+01 2.73E-02 1.12E+00 3.08E+02  
 7.03E-01 5.01E-01  
 8.06E+00 1.77E-02 2.24E+00 1.95E+01 7.03E+00 1.88E+01 1.88E+01 2.70E-02 1.12E+00 3.09E+02  
 7.03E-01 5.04E-01  
 8.24E+00 2.99E-02 2.27E+00 1.95E+01 7.03E+00 1.91E+01 1.91E+01 2.67E-02 1.12E+00 3.09E+02  
 7.03E-01 5.08E-01  
 8.46E+00 4.71E-02 2.30E+00 1.95E+01 7.03E+00 1.94E+01 1.94E+01 2.63E-02 1.12E+00 3.09E+02  
 7.03E-01 5.11E-01  
 8.70E+00 7.12E-02 2.33E+00 1.95E+01 7.03E+00 1.97E+01 1.97E+01 2.59E-02 1.12E+00 3.09E+02  
 7.04E-01 5.16E-01  
 8.99E+00 1.05E-01 2.37E+00 1.96E+01 7.03E+00 2.01E+01 2.01E+01 2.54E-02 1.12E+00 3.09E+02  
 7.04E-01 5.20E-01  
 9.33E+00 1.51E-01 2.42E+00 1.96E+01 7.03E+00 2.06E+01 2.06E+01 2.49E-02 1.12E+00 3.09E+02  
 7.05E-01 5.26E-01  
 9.73E+00 2.14E-01 2.47E+00 1.96E+01 7.03E+00 2.11E+01 2.11E+01 2.43E-02 1.12E+00 3.09E+02  
 7.06E-01 5.31E-01  
 1.02E+01 2.99E-01 2.53E+00 1.96E+01 7.03E+00 2.17E+01 2.17E+01 2.37E-02 1.12E+00 3.09E+02  
 7.07E-01 5.38E-01  
 1.07E+01 4.15E-01 2.59E+00 1.96E+01 7.03E+00 2.25E+01 2.25E+01 2.31E-02 1.12E+00 3.09E+02  
 7.08E-01 5.45E-01  
 1.14E+01 5.72E-01 2.66E+00 1.97E+01 7.03E+00 2.34E+01 2.34E+01 2.24E-02 1.12E+00 3.09E+02  
 7.09E-01 5.53E-01  
 1.21E+01 7.81E-01 2.73E+00 1.97E+01 7.03E+00 2.44E+01 2.44E+01 2.17E-02 1.12E+00 3.09E+02  
 7.11E-01 5.61E-01  
 1.30E+01 1.06E+00 2.81E+00 1.97E+01 7.03E+00 2.56E+01 2.56E+01 2.10E-02 1.12E+00 3.09E+02  
 7.14E-01 5.70E-01  
 1.40E+01 1.43E+00 2.90E+00 1.98E+01 7.03E+00 2.70E+01 2.70E+01 2.02E-02 1.12E+00 3.09E+02  
 7.16E-01 5.79E-01  
 1.52E+01 1.91E+00 2.95E+00 1.98E+01 7.01E+00 2.86E+01 2.86E+01 1.89E-02 1.12E+00 3.09E+02  
 7.54E-01 6.27E-01  
 1.66E+01 2.48E+00 2.95E+00 1.98E+01 6.99E+00 3.05E+01 3.05E+01 1.79E-02 1.12E+00 3.09E+02  
 7.98E-01 6.79E-01  
 1.82E+01 3.18E+00 2.92E+00 1.98E+01 6.97E+00 3.27E+01 3.27E+01 1.71E-02 1.12E+00 3.09E+02  
 8.47E-01 7.35E-01  
 2.01E+01 4.03E+00 2.86E+00 1.98E+01 6.95E+00 3.53E+01 3.53E+01 1.63E-02 1.12E+00 3.09E+02  
 9.01E-01 7.96E-01  
 2.24E+01 5.05E+00 2.80E+00 1.98E+01 6.92E+00 3.84E+01 3.84E+01 1.57E-02 1.12E+00 3.09E+02  
 9.61E-01 8.61E-01  
 2.50E+01 6.27E+00 2.73E+00 1.98E+01 6.90E+00 4.20E+01 4.20E+01 1.51E-02 1.12E+00 3.10E+02  
 1.03E+00 9.31E-01

2.80E+01 7.74E+00 2.65E+00 1.98E+01 6.88E+00 4.62E+01 4.62E+01 1.45E-02 1.12E+00 3.10E+02  
 1.09E+00 1.00E+00  
 3.16E+01 9.48E+00 2.58E+00 1.99E+01 6.85E+00 5.11E+01 5.11E+01 1.39E-02 1.12E+00 3.10E+02  
 1.17E+00 1.08E+00  
 3.58E+01 1.15E+01 2.51E+00 1.99E+01 6.83E+00 5.68E+01 5.68E+01 1.34E-02 1.12E+00 3.10E+02  
 1.24E+00 1.16E+00  
 4.07E+01 1.40E+01 2.45E+00 2.00E+01 6.81E+00 6.35E+01 6.35E+01 1.29E-02 1.12E+00 3.10E+02  
 1.32E+00 1.25E+00  
 4.64E+01 1.69E+01 2.40E+00 2.02E+01 6.79E+00 7.13E+01 7.13E+01 1.23E-02 1.12E+00 3.10E+02  
 1.40E+00 1.33E+00  
 5.31E+01 2.03E+01 2.35E+00 2.03E+01 6.78E+00 8.05E+01 8.05E+01 1.18E-02 1.12E+00 3.10E+02  
 1.48E+00 1.42E+00  
 6.09E+01 2.43E+01 2.31E+00 2.05E+01 6.76E+00 9.12E+01 9.12E+01 1.12E-02 1.12E+00 3.10E+02  
 1.57E+00 1.51E+00  
 7.01E+01 2.90E+01 2.27E+00 2.08E+01 6.75E+00 1.04E+02 1.04E+02 1.07E-02 1.12E+00 3.10E+02  
 1.65E+00 1.60E+00  
 8.08E+01 3.45E+01 2.25E+00 2.11E+01 6.73E+00 1.18E+02 1.18E+02 1.01E-02 1.12E+00 3.10E+02  
 1.74E+00 1.69E+00  
 9.33E+01 4.10E+01 2.23E+00 2.14E+01 6.72E+00 1.36E+02 1.36E+02 9.57E-03 1.12E+00 3.10E+02  
 1.82E+00 1.78E+00  
 1.08E+02 4.85E+01 2.22E+00 2.18E+01 6.71E+00 1.56E+02 1.56E+02 9.01E-03 1.12E+00 3.10E+02  
 1.91E+00 1.87E+00  
 1.25E+02 5.73E+01 2.22E+00 2.24E+01 6.70E+00 1.79E+02 1.79E+02 8.45E-03 1.12E+00 3.10E+02  
 1.99E+00 1.96E+00  
 1.45E+02 6.76E+01 2.22E+00 2.30E+01 6.69E+00 2.07E+02 2.07E+02 7.88E-03 1.12E+00 3.10E+02  
 2.07E+00 2.04E+00  
 1.69E+02 7.96E+01 2.24E+00 2.37E+01 6.68E+00 2.39E+02 2.39E+02 7.32E-03 1.12E+00 3.10E+02  
 2.15E+00 2.13E+00  
 1.96E+02 9.34E+01 2.25E+00 2.45E+01 6.67E+00 2.77E+02 2.77E+02 6.77E-03 1.12E+00 3.10E+02  
 2.23E+00 2.21E+00  
 2.28E+02 1.10E+02 2.28E+00 2.55E+01 6.67E+00 3.21E+02 3.21E+02 6.24E-03 1.12E+00 3.10E+02  
 2.31E+00 2.29E+00  
 2.66E+02 1.28E+02 2.30E+00 2.67E+01 6.66E+00 3.72E+02 3.72E+02 5.73E-03 1.12E+00 3.10E+02  
 2.38E+00 2.37E+00  
 3.10E+02 1.50E+02 2.33E+00 2.80E+01 6.66E+00 4.33E+02 4.32E+02 5.24E-03 1.12E+00 3.10E+02  
 2.45E+00 2.44E+00  
 3.62E+02 1.75E+02 2.35E+00 2.96E+01 6.65E+00 5.03E+02 5.03E+02 4.80E-03 1.12E+00 3.10E+02  
 2.51E+00 2.51E+00  
 4.22E+02 2.04E+02 2.36E+00 3.14E+01 6.65E+00 5.86E+02 5.86E+02 4.39E-03 1.12E+00 3.10E+02  
 2.57E+00 2.57E+00  
 4.92E+02 2.38E+02 2.35E+00 3.36E+01 6.65E+00 6.82E+02 6.82E+02 4.04E-03 1.12E+00 3.10E+02  
 2.62E+00 2.63E+00  
 5.75E+02 2.59E+02 2.33E+00 3.61E+01 6.65E+00 7.95E+02 7.95E+02 3.75E-03 1.12E+00 3.10E+02  
 2.65E+00 2.65E+00  
 6.71E+02 2.59E+02 2.33E+00 3.89E+01 6.65E+00 7.96E+02 7.95E+02 3.47E-03 1.12E+00 3.10E+02  
 2.65E+00 2.65E+00







2.00E+03 1.05E-03 1.05E-03 9.77E-01 2.19E-02 2.19E-02 1.66E+00 0.00E+00 0.00E+00 2.60E-05  
3.89E-02 1.02E-02  
1

time averaged (tav = 1800. s) volume concentration: concentration contour parameters

$$c(x,y,z,t) = cc(x) * (\text{erf}(xa) - \text{erf}(xb)) * (\text{erf}(ya) - \text{erf}(yb)) * (\exp(-za^*za) + \exp(-zb^*zb))$$

$c(x,y,z,t)$  = concentration (volume fraction) at  $(x,y,z,t)$

$x$  = downwind distance (m)

y = crosswind horizontal distance (m)

$z$  = height (m)

$t$  = time (s)

erf = error function

$$xa = (x - xc + bx) / (sr2 * betax)$$

$$xb = (x - xc - bx) / (sr2 * betax)$$

$$ya = (y+b)/(sr2^*\beta ac)$$

$$yb = (y-b)/(sr2^*betac)$$

**exp** = exponential function

$$za = (z-zc)/(sr2^*sig)$$

$$zb = (z+zc)/(sr2^*\cdot sig)$$

```
sr2 = sqrt(2.0)
```

x	cc(x)	b(x)	betac(x)	zc(x)	sig(x)	t	xc(t)	bx(t)	betax(t)		
-7.78E+00	0.00E+00	7.00E+00	1.96E+00	0.00E+00	0.00E+00			2.59E+01	0.00E+00	7.78E+00	
6.35E-02											
-6.22E+00	5.59E-03	7.00E+00	2.04E+00	0.00E+00	6.86E-01			2.95E+01	7.78E-01	8.84E+00	7.22E-02
-4.67E+00	8.25E-03	7.00E+00	2.14E+00	0.00E+00	9.04E-01			3.30E+01	1.56E+00	9.91E+00	8.09E-02
-3.11E+00	1.03E-02	7.00E+00	2.32E+00	0.00E+00	1.20E+00			4.68E+01	2.33E+00	1.10E+01	8.96E-02
-1.56E+00	1.21E-02	7.00E+00	2.69E+00	0.00E+00	1.82E+00			6.06E+01	3.11E+00	1.20E+01	9.83E-02
9.54E-07	1.32E-02	7.00E+00	5.13E+00	0.00E+00	3.10E+00			7.15E+01	3.89E+00	1.31E+01	1.07E-01
1.56E+00	1.43E-02	7.00E+00	5.44E+00	0.00E+00	2.01E+00			8.24E+01	4.67E+00	1.42E+01	1.16E-01
3.11E+00	1.53E-02	7.00E+00	8.85E+00	0.00E+00	2.33E+00			8.46E+01	5.44E+00	1.52E+01	1.24E-01
4.67E+00	1.60E-02	7.00E+00	1.03E+01	0.00E+00	5.36E+00			8.68E+01	6.22E+00	1.63E+01	1.33E-01
6.22E+00	1.37E-02	7.01E+00	1.04E+01	0.00E+00	1.04E+00			8.88E+01	7.00E+00	1.74E+01	1.42E-01

7.78E+00	1.33E-02	7.02E+00	1.05E+01	3.36E-03	1.25E+00		9.09E+01	7.78E+00	1.84E+01	1.51E-01
7.91E+00	1.32E-02	7.03E+00	1.05E+01	9.23E-03	1.27E+00		9.12E+01	7.91E+00	1.86E+01	1.52E-01
8.06E+00	1.31E-02	7.03E+00	1.05E+01	1.77E-02	1.28E+00		9.17E+01	8.06E+00	1.88E+01	1.54E-01
8.24E+00	1.30E-02	7.03E+00	1.05E+01	2.99E-02	1.29E+00		9.22E+01	8.24E+00	1.91E+01	1.56E-01
8.46E+00	1.29E-02	7.03E+00	1.05E+01	4.71E-02	1.30E+00		9.28E+01	8.46E+00	1.94E+01	1.58E-01
8.70E+00	1.29E-02	7.03E+00	1.06E+01	7.12E-02	1.31E+00		9.35E+01	8.70E+00	1.97E+01	1.61E-01
8.99E+00	1.28E-02	7.03E+00	1.06E+01	1.05E-01	1.31E+00		9.43E+01	8.99E+00	2.01E+01	1.64E-01
9.33E+00	1.28E-02	7.03E+00	1.06E+01	1.51E-01	1.31E+00		9.53E+01	9.33E+00	2.06E+01	1.68E-01
9.73E+00	1.29E-02	7.03E+00	1.06E+01	2.14E-01	1.30E+00		9.64E+01	9.73E+00	2.11E+01	1.72E-01
1.02E+01	1.30E-02	7.03E+00	1.06E+01	2.99E-01	1.29E+00		9.77E+01	1.02E+01	2.17E+01	1.78E-01
1.07E+01	1.33E-02	7.03E+00	1.06E+01	4.15E-01	1.26E+00		9.93E+01	1.07E+01	2.25E+01	1.84E-01
1.14E+01	1.39E-02	7.03E+00	1.06E+01	5.72E-01	1.20E+00		1.01E+02	1.14E+01	2.34E+01	1.91E-01
1.21E+01	1.48E-02	7.03E+00	1.07E+01	7.81E-01	1.13E+00		1.03E+02	1.21E+01	2.44E+01	1.99E-01
1.30E+01	1.64E-02	7.03E+00	1.07E+01	1.06E+00	1.01E+00		1.06E+02	1.30E+01	2.56E+01	2.09E-01
1.40E+01	1.95E-02	7.03E+00	1.07E+01	1.43E+00	8.49E-01		1.08E+02	1.40E+01	2.70E+01	2.20E-01
1.52E+01	1.85E-02	7.01E+00	1.07E+01	1.91E+00	8.52E-01		1.12E+02	1.52E+01	2.86E+01	2.33E-01
1.66E+01	1.76E-02	6.99E+00	1.07E+01	2.48E+00	8.52E-01		1.15E+02	1.66E+01	3.05E+01	2.49E-01
1.82E+01	1.68E-02	6.97E+00	1.07E+01	3.18E+00	8.42E-01		1.19E+02	1.82E+01	3.27E+01	2.67E-01
2.01E+01	1.61E-02	6.95E+00	1.07E+01	4.03E+00	8.27E-01		1.24E+02	2.01E+01	3.53E+01	2.89E-01
2.24E+01	1.56E-02	6.92E+00	1.08E+01	5.05E+00	8.07E-01		1.28E+02	2.24E+01	3.84E+01	3.14E-01
2.50E+01	1.50E-02	6.90E+00	1.08E+01	6.27E+00	7.87E-01		1.34E+02	2.50E+01	4.20E+01	3.43E-01
2.80E+01	1.46E-02	6.88E+00	1.08E+01	7.74E+00	7.66E-01		1.39E+02	2.80E+01	4.62E+01	3.77E-01
3.16E+01	1.41E-02	6.85E+00	1.09E+01	9.48E+00	7.45E-01		1.46E+02	3.16E+01	5.11E+01	4.17E-01

3.58E+01	1.37E-02	6.83E+00	1.10E+01	1.15E+01	7.25E-01		1.53E+02	3.58E+01	5.68E+01	4.64E-01
4.07E+01	1.33E-02	6.81E+00	1.11E+01	1.40E+01	7.08E-01		1.60E+02	4.07E+01	6.35E+01	5.18E-01
4.64E+01	1.29E-02	6.79E+00	1.12E+01	1.69E+01	6.92E-01		1.69E+02	4.64E+01	7.13E+01	5.82E-01
5.31E+01	1.25E-02	6.78E+00	1.14E+01	2.03E+01	6.78E-01		1.78E+02	5.31E+01	8.05E+01	6.57E-01
6.09E+01	1.21E-02	6.76E+00	1.16E+01	2.43E+01	6.66E-01		1.88E+02	6.09E+01	9.12E+01	7.45E-01
7.01E+01	1.18E-02	6.75E+00	1.18E+01	2.90E+01	6.57E-01		2.00E+02	7.01E+01	1.04E+02	8.47E-01
8.08E+01	1.15E-02	6.73E+00	1.21E+01	3.45E+01	6.49E-01		2.12E+02	8.08E+01	1.18E+02	9.67E-01
9.33E+01	1.11E-02	6.72E+00	1.25E+01	4.10E+01	6.44E-01	1.11E+00	2.26E+02	9.33E+01	1.36E+02	
1.08E+02	1.09E-02	6.71E+00	1.29E+01	4.85E+01	6.41E-01	1.27E+00	2.42E+02	1.08E+02	1.56E+02	
1.25E+02	1.06E-02	6.70E+00	1.35E+01	5.73E+01	6.41E-01	1.46E+00	2.60E+02	1.25E+02	1.79E+02	
1.45E+02	1.04E-02	6.69E+00	1.42E+01	6.76E+01	6.42E-01	1.69E+00	2.79E+02	1.45E+02	2.07E+02	
1.69E+02	1.02E-02	6.68E+00	1.50E+01	7.96E+01	6.46E-01	1.95E+00	3.02E+02	1.69E+02	2.39E+02	
1.96E+02	1.00E-02	6.67E+00	1.60E+01	9.34E+01	6.51E-01	2.26E+00	3.27E+02	1.96E+02	2.77E+02	
2.28E+02	9.90E-03	6.67E+00	1.72E+01	1.10E+02	6.57E-01	2.62E+00	3.55E+02	2.28E+02	3.21E+02	
2.66E+02	9.83E-03	6.66E+00	1.87E+01	1.28E+02	6.64E-01	3.04E+00	3.87E+02	2.66E+02	3.72E+02	
3.10E+02	9.80E-03	6.66E+00	2.04E+01	1.50E+02	6.71E-01	3.53E+00	4.24E+02	3.10E+02	4.32E+02	
3.62E+02	9.84E-03	6.65E+00	2.25E+01	1.75E+02	6.77E-01	4.11E+00	4.65E+02	3.62E+02	5.03E+02	
4.22E+02	9.96E-03	6.65E+00	2.49E+01	2.04E+02	6.80E-01	4.78E+00	5.13E+02	4.22E+02	5.86E+02	
4.92E+02	1.02E-02	6.65E+00	2.77E+01	2.38E+02	6.78E-01	5.57E+00	5.67E+02	4.92E+02	6.82E+02	
5.75E+02	1.06E-02	6.65E+00	3.11E+01	2.59E+02	6.73E-01	6.49E+00	6.29E+02	5.75E+02	7.95E+02	
6.71E+02	1.10E-02	6.65E+00	3.49E+01	2.59E+02	6.74E-01	1.96E+01	6.36E+02	6.71E+02	7.95E+02	
7.84E+02	1.14E-02	6.65E+00	3.95E+01	2.59E+02	6.74E-01	2.81E+01	6.79E+02	7.84E+02	7.95E+02	
9.16E+02	1.18E-02	6.65E+00	4.47E+01	2.59E+02	6.75E-01	3.55E+01	7.29E+02	9.16E+02	7.95E+02	

1.07E+03	1.22E-02	6.65E+00	5.07E+01	2.59E+02	6.75E-01	7.87E+02	1.07E+03	7.95E+02
4.25E+01								
1.25E+03	1.26E-02	6.65E+00	5.76E+01	2.59E+02	6.76E-01	8.55E+02	1.25E+03	7.95E+02
4.95E+01								
1.46E+03	1.30E-02	6.65E+00	6.55E+01	2.59E+02	6.77E-01	9.35E+02	1.46E+03	7.95E+02
5.66E+01								
1.71E+03	1.33E-02	6.65E+00	7.45E+01	2.59E+02	6.79E-01	1.03E+03	1.71E+03	7.95E+02
6.40E+01								
2.00E+03	1.36E-02	6.65E+00	8.47E+01	2.59E+02	6.80E-01	1.14E+03	2.00E+03	7.95E+02
7.16E+01								
1								

time averaged (tav = 1800. s) volume concentration: concentration in the z = 1.50 plane.

downwind distance x (m)	time of max conc (s)	cloud duration bbc (m)	effective half width bbc (m)	average concentration (volume fraction) at (x,y,z) y/bbc= 0.0 0.5 1.0 1.5 2.0 2.5
-7.78E+00	3.04E+02	6.00E+02	7.78E+00	0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0.00E+00				
-6.22E+00	3.03E+02	6.00E+02	7.84E+00	1.37E-03 1.28E-03 4.65E-04 1.34E-05 1.44E-08
0.00E+00				
-4.67E+00	3.02E+02	6.00E+02	7.92E+00	5.55E-03 5.12E-03 1.85E-03 6.28E-05 1.01E-07
0.00E+00				
-3.11E+00	3.02E+02	6.00E+02	8.07E+00	1.25E-02 1.13E-02 4.04E-03 1.73E-04 4.97E-07
0.00E+00				
-1.56E+00	3.01E+02	6.00E+02	8.41E+00	2.27E-02 1.95E-02 6.90E-03 4.22E-04 2.98E-06
2.05E-09				
9.54E-07	3.00E+02	6.00E+02	1.13E+01	2.59E-02 1.87E-02 6.26E-03 8.13E-04 3.63E-05
5.24E-07				
1.56E+00	3.01E+02	6.00E+02	1.17E+01	2.31E-02 1.65E-02 5.52E-03 7.36E-04 3.53E-05
5.73E-07				
3.11E+00	3.02E+02	6.00E+02	1.69E+01	1.90E-02 1.31E-02 4.29E-03 6.41E-04 4.23E-05
1.20E-06				
4.67E+00	3.02E+02	6.00E+02	1.91E+01	2.06E-02 1.42E-02 4.64E-03 7.01E-04 4.80E-05
1.46E-06				
6.22E+00	3.03E+02	6.00E+02	1.94E+01	6.38E-03 4.40E-03 1.44E-03 2.17E-04 1.49E-05
4.54E-07				
7.78E+00	3.04E+02	6.00E+02	1.95E+01	8.50E-03 5.87E-03 1.91E-03 2.89E-04 1.99E-05
6.08E-07				
7.91E+00	3.04E+02	6.00E+02	1.95E+01	8.70E-03 6.00E-03 1.96E-03 2.96E-04 2.03E-05
6.22E-07				
8.06E+00	3.04E+02	6.00E+02	1.95E+01	8.72E-03 6.02E-03 1.96E-03 2.97E-04 2.04E-05
6.23E-07				
8.24E+00	3.04E+02	6.00E+02	1.96E+01	8.74E-03 6.03E-03 1.97E-03 2.97E-04 2.04E-05
6.25E-07				





2.00E+03	1.14E+03	6.07E+02	1.47E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00								
1								

time averaged (tav = 1800. s) volume concentration: maximum concentration (volume fraction) along centerline.

downwind distance x (m)	height z (m)	maximum concentration c(x,0,z) (s)	time of max conc (s)	cloud duration (s)
-7.78E+00	0.00E+00	0.00E+00	3.04E+02	6.00E+02
-6.22E+00	0.00E+00	1.49E-02	3.03E+02	6.00E+02
-4.67E+00	0.00E+00	2.20E-02	3.02E+02	6.00E+02
-3.11E+00	0.00E+00	2.74E-02	3.02E+02	6.00E+02
-1.56E+00	0.00E+00	3.19E-02	3.01E+02	6.00E+02
9.54E-07	0.00E+00	2.91E-02	3.00E+02	6.00E+02
1.56E+00	0.00E+00	3.05E-02	3.01E+02	6.00E+02
3.11E+00	0.00E+00	2.33E-02	3.02E+02	6.00E+02
4.67E+00	0.00E+00	2.14E-02	3.02E+02	6.00E+02
6.22E+00	0.00E+00	1.82E-02	3.03E+02	6.00E+02
7.78E+00	0.00E+00	1.75E-02	3.04E+02	6.00E+02
7.91E+00	0.00E+00	1.74E-02	3.04E+02	6.00E+02
8.06E+00	0.00E+00	1.73E-02	3.04E+02	6.00E+02
8.24E+00	0.00E+00	1.71E-02	3.04E+02	6.00E+02
8.46E+00	0.00E+00	1.70E-02	3.04E+02	6.00E+02
8.70E+00	0.00E+00	1.69E-02	3.05E+02	6.00E+02
8.99E+00	0.00E+00	1.68E-02	3.05E+02	6.00E+02
9.33E+00	0.00E+00	1.67E-02	3.05E+02	6.00E+02
9.73E+00	0.00E+00	1.67E-02	3.05E+02	6.00E+02
1.02E+01	0.00E+00	1.66E-02	3.05E+02	6.00E+02
1.07E+01	0.00E+00	1.65E-02	3.06E+02	6.00E+02
1.14E+01	0.00E+00	1.62E-02	3.06E+02	6.00E+02
1.21E+01	0.00E+00	1.52E-02	3.06E+02	6.00E+02
1.30E+01	5.31E-01	1.24E-02	3.07E+02	6.00E+02
1.40E+01	1.42E+00	1.27E-02	3.07E+02	6.00E+02
1.52E+01	1.91E+00	1.20E-02	3.08E+02	6.00E+02
1.66E+01	2.48E+00	1.13E-02	3.09E+02	6.00E+02
1.82E+01	3.18E+00	1.08E-02	3.10E+02	6.00E+02
2.01E+01	4.03E+00	1.03E-02	3.11E+02	6.00E+02
2.24E+01	5.05E+00	9.90E-03	3.12E+02	6.00E+02
2.50E+01	6.27E+00	9.51E-03	3.13E+02	6.00E+02
2.80E+01	7.74E+00	9.13E-03	3.15E+02	6.00E+02
3.16E+01	9.48E+00	8.76E-03	3.16E+02	6.00E+02
3.58E+01	1.15E+01	8.40E-03	3.19E+02	6.00E+02
4.07E+01	1.40E+01	8.04E-03	3.21E+02	6.00E+02
4.64E+01	1.69E+01	7.68E-03	3.24E+02	6.00E+02

5.31E+01	2.03E+01	7.31E-03	3.28E+02	6.00E+02
6.09E+01	2.43E+01	6.94E-03	3.32E+02	6.00E+02
7.01E+01	2.90E+01	6.55E-03	3.37E+02	6.00E+02
8.08E+01	3.45E+01	6.16E-03	3.42E+02	6.00E+02
9.33E+01	4.10E+01	5.76E-03	3.49E+02	6.00E+02
1.08E+02	4.85E+01	5.35E-03	3.56E+02	6.00E+02
1.25E+02	5.73E+01	4.93E-03	3.65E+02	6.00E+02
1.45E+02	6.76E+01	4.52E-03	3.76E+02	6.00E+02
1.69E+02	7.96E+01	4.10E-03	3.88E+02	6.00E+02
1.96E+02	9.34E+01	3.70E-03	4.02E+02	6.00E+02
2.28E+02	1.10E+02	3.31E-03	4.19E+02	6.00E+02
2.66E+02	1.28E+02	2.94E-03	4.39E+02	6.00E+02
3.10E+02	1.50E+02	2.60E-03	4.62E+02	6.00E+02
3.62E+02	1.75E+02	2.29E-03	4.89E+02	6.00E+02
4.22E+02	2.04E+02	2.01E-03	5.20E+02	6.00E+02
4.92E+02	2.38E+02	1.78E-03	5.57E+02	6.00E+02
5.75E+02	2.59E+02	1.59E-03	6.00E+02	6.00E+02
6.71E+02	2.59E+02	1.41E-03	6.36E+02	6.00E+02
7.84E+02	2.59E+02	1.25E-03	6.79E+02	6.01E+02
9.16E+02	2.59E+02	1.11E-03	7.29E+02	6.02E+02
1.07E+03	2.59E+02	9.75E-04	7.87E+02	6.02E+02
1.25E+03	2.59E+02	8.57E-04	8.55E+02	6.03E+02
1.46E+03	2.59E+02	7.53E-04	9.35E+02	6.04E+02
1.71E+03	2.59E+02	6.61E-04	1.03E+03	6.05E+02
2.00E+03	2.59E+02	5.80E-04	1.14E+03	6.07E+02

```
*****
***      BEE-LINE SOFTWARE      ***
***      SLAB VERSION 5.0       ***
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*****
```

#### SESSION INFORMATION

INPUT DATA FILE NAME : C:\CALPINE\IEEC\NH3HOSE.SLB  
OUTPUT LIST FILE NAME : C:\CALPINE\IEECNH3HOSE.LST

problem input

```
idspl =      1
ncalc =      1
wms  =  0.017031
cps  =  2093.65
tbp  =  239.70
cmed0 =  0.83
dhe  = 1370837.
cpsl =  4956.39
rhosl =  639.00
spb  = 2132.50
spc  = -32.98
ts   =  310.72
qs   =  0.05
as   =  12.50
tsd  =  600.
qtis =  0.00
hs   =  0.00
tav  = 3600.00
xffm = 2000.00
zp(1)=  1.50
zp(2)=  0.00
zp(3)=  0.00
zp(4)=  0.00
z0   = 0.100000
za   =  10.00
```

ua = 3.00  
ta = 298.16  
rh = 50.00  
stab = 4.00

#### release gas properties

molecular weight of source gas (kg)	- wms = 1.7031E-02
vapor heat capacity, const. p. (j/kg-k)	- cps = 2.0936E+03
temperature of source gas (k)	- ts = 2.3970E+02
density of source gas (kg/m3)	- rhos = 8.6589E-01
boiling point temperature	- tbp = 2.3970E+02
liquid mass fraction	- cmcd0= 0.0000E+00
liquid heat capacity (j/kg-k)	- cpsl = 4.9564E+03
heat of vaporization (j/kg)	- dhe = 1.3708E+06
liquid source density (kg/m3)	- rho1= 6.3900E+02
saturation pressure constant	- spa = 1.0316E+01
saturation pressure constant (k)	- spb = 2.1325E+03
saturation pressure constant (k)	- spc = -3.2980E+01

#### spill characteristics

spill type	- idspl= 1
mass source rate (kg/s)	- qs = 5.2400E-02
continuous source duration (s)	- tsd = 6.0000E+02
continuous source mass (kg)	- qtcs = 3.1440E+01
instantaneous source mass (kg)	- qtis = 0.0000E+00
source area (m2)	- as = 1.2500E+01
vertical vapor velocity (m/s)	- ws = 4.8413E-03
source half width (m)	- bs = 1.7678E+00
source height (m)	- hs = 0.0000E+00
horizontal vapor velocity (m/s)	- us = 0.0000E+00

#### field parameters

concentration averaging time (s)	- tav = 3.6000E+03
mixing layer height (m)	- hmx = 1.0400E+03
maximum downwind distrace (m)	- xffm = 2.0000E+03
concentration measurement height (m)	- zp(1)= 1.5000E+00
	- zp(2)= 0.0000E+00
	- zp(3)= 0.0000E+00
	- zp(4)= 0.0000E+00

### ambient meteorological properties

molecular weight of ambient air (kg) - wmae = 2.8780E-02  
heat capacity of ambient air at const p. (J/kg-k)- cpaa = 1.0145E+03  
density of ambient air (kg/m3) - rhoa = 1.1763E+00  
ambient measurement height (m) - za = 1.0000E+01  
ambient atmospheric pressure (pa=n/m2=j/m3) - pa = 1.0133E+05  
ambient wind speed (m/s) - ua = 3.0000E+00  
ambient temperature (k) - ta = 2.9816E+02  
relative humidity (percent) - rh = 5.0000E+01  
ambient friction velocity (m/s) - uastr = 2.6764E-01  
atmospheric stability class value - stab = 4.0000E+00  
inverse monin-obukhov length (1/m) - ala = 0.0000E+00  
surface roughness height (m) - z0 = 1.0000E-01

### additional parameters

sub-step multiplier - ncalc = 1  
number of calculational sub-steps - nssm = 3  
acceleration of gravity (m/s2) - grav = 9.8067E+00  
gas constant (j/mol- k) - rr = 8.3143E+00  
von karman constant - xk = 4.1000E-01

1

### instantaneous spatially averaged cloud parameters

x	zc	h	bb	b	bbx	bx	cv	rho	t	u	ua
-1.77E+00	0.00E+00	0.00E+00	1.77E+00	1.59E+00	1.77E+00	1.77E+00	0.00E+00	1.18E+00	2.98E+02	0.00E+00	0.00E+00
-1.41E+00	0.00E+00	5.20E-01	1.80E+00	1.59E+00	1.96E+00	1.96E+00	6.82E-03	1.17E+00	2.98E+02	5.90E-01	5.93E-01
-1.06E+00	0.00E+00	7.00E-01	1.82E+00	1.59E+00	2.15E+00	2.15E+00	8.02E-03	1.17E+00	2.98E+02	7.37E-01	7.44E-01
-7.07E-01	0.00E+00	8.43E-01	1.84E+00	1.59E+00	2.34E+00	2.34E+00	8.75E-03	1.17E+00	2.98E+02	8.32E-01	8.43E-01
-3.54E-01	0.00E+00	9.66E-01	1.86E+00	1.59E+00	2.53E+00	2.53E+00	9.27E-03	1.17E+00	2.98E+02	9.04E-01	9.19E-01
1.04E-07	0.00E+00	1.08E+00	1.88E+00	1.59E+00	2.72E+00	2.72E+00	9.66E-03	1.17E+00	2.98E+02	9.61E-01	9.81E-01
3.54E-01	0.00E+00	1.18E+00	1.90E+00	1.59E+00	2.91E+00	2.91E+00	9.98E-03	1.17E+00	2.98E+02	1.01E+00	1.03E+00
7.07E-01	0.00E+00	1.28E+00	1.92E+00	1.59E+00	3.10E+00	3.10E+00	1.02E-02	1.17E+00	2.98E+02	1.05E+00	1.08E+00
1.06E+00	0.00E+00	1.37E+00	1.94E+00	1.59E+00	3.29E+00	3.29E+00	1.04E-02	1.17E+00	2.97E+02	1.08E+00	1.12E+00
1.41E+00	0.00E+00	1.46E+00	1.96E+00	1.59E+00	3.48E+00	3.48E+00	1.06E-02	1.17E+00	2.97E+02	1.12E+00	1.16E+00
1.77E+00	3.61E-05	1.54E+00	1.98E+00	1.59E+00	3.67E+00	3.67E+00	1.08E-02	1.17E+00	2.97E+02	1.14E+00	1.19E+00
1.80E+00	1.13E-04	1.55E+00	1.98E+00	1.59E+00	3.71E+00	3.71E+00	1.07E-02	1.17E+00	2.97E+02	1.14E+00	1.19E+00
1.85E+00	2.31E-04	1.56E+00	1.98E+00	1.59E+00	3.76E+00	3.76E+00	1.05E-02	1.17E+00	2.97E+02	1.15E+00	1.20E+00
1.90E+00	4.10E-04	1.57E+00	1.99E+00	1.59E+00	3.82E+00	3.82E+00	1.04E-02	1.17E+00	2.97E+02	1.15E+00	1.20E+00
1.96E+00	6.77E-04	1.59E+00	1.99E+00	1.59E+00	3.89E+00	3.89E+00	1.03E-02	1.17E+00	2.98E+02	1.16E+00	1.21E+00
2.04E+00	1.07E-03	1.60E+00	1.99E+00	1.59E+00	3.97E+00	3.97E+00	1.01E-02	1.17E+00	2.98E+02	1.17E+00	1.21E+00

2.13E+00	1.64E-03	1.62E+00	2.00E+00	1.59E+00	4.07E+00	4.07E+00	9.87E-03	1.17E+00	2.98E+02	1.17E+00	1.22E+00
2.24E+00	2.46E-03	1.64E+00	2.01E+00	1.59E+00	4.19E+00	4.19E+00	9.63E-03	1.17E+00	2.98E+02	1.18E+00	1.23E+00
2.38E+00	3.63E-03	1.67E+00	2.01E+00	1.59E+00	4.33E+00	4.33E+00	9.35E-03	1.17E+00	2.98E+02	1.19E+00	1.24E+00
2.54E+00	5.29E-03	1.70E+00	2.02E+00	1.59E+00	4.51E+00	4.51E+00	9.04E-03	1.17E+00	2.98E+02	1.21E+00	1.25E+00
2.73E+00	7.59E-03	1.74E+00	2.04E+00	1.59E+00	4.72E+00	4.72E+00	8.69E-03	1.17E+00	2.98E+02	1.22E+00	1.26E+00
2.97E+00	1.08E-02	1.78E+00	2.05E+00	1.59E+00	4.97E+00	4.97E+00	8.30E-03	1.17E+00	2.98E+02	1.24E+00	1.28E+00
3.25E+00	1.51E-02	1.84E+00	2.06E+00	1.59E+00	5.28E+00	5.27E+00	7.87E-03	1.17E+00	2.98E+02	1.26E+00	1.29E+00
3.59E+00	2.10E-02	1.90E+00	2.08E+00	1.59E+00	5.64E+00	5.64E+00	7.41E-03	1.17E+00	2.98E+02	1.28E+00	1.31E+00
4.00E+00	2.89E-02	1.97E+00	2.11E+00	1.59E+00	6.09E+00	6.09E+00	6.91E-03	1.17E+00	2.98E+02	1.31E+00	1.34E+00
4.50E+00	3.92E-02	2.06E+00	2.14E+00	1.59E+00	6.62E+00	6.62E+00	6.39E-03	1.17E+00	2.98E+02	1.34E+00	1.36E+00
5.09E+00	5.27E-02	2.16E+00	2.17E+00	1.59E+00	7.26E+00	7.26E+00	5.86E-03	1.17E+00	2.98E+02	1.37E+00	1.39E+00
5.81E+00	7.00E-02	2.28E+00	2.21E+00	1.59E+00	8.04E+00	8.04E+00	5.31E-03	1.18E+00	2.98E+02	1.40E+00	1.43E+00
6.68E+00	9.19E-02	2.42E+00	2.26E+00	1.59E+00	8.97E+00	8.97E+00	4.77E-03	1.18E+00	2.98E+02	1.44E+00	1.46E+00
7.72E+00	1.19E-01	2.58E+00	2.32E+00	1.59E+00	1.01E+01	1.01E+01	4.23E-03	1.18E+00	2.98E+02	1.49E+00	1.50E+00
8.98E+00	1.53E-01	2.77E+00	2.39E+00	1.59E+00	1.15E+01	1.15E+01	3.71E-03	1.18E+00	2.98E+02	1.53E+00	1.55E+00
1.05E+01	1.94E-01	2.98E+00	2.48E+00	1.59E+00	1.31E+01	1.31E+01	3.22E-03	1.18E+00	2.98E+02	1.58E+00	1.59E+00
1.23E+01	2.43E-01	3.23E+00	2.58E+00	1.59E+00	1.51E+01	1.51E+01	2.76E-03	1.18E+00	2.98E+02	1.63E+00	1.64E+00
1.45E+01	3.01E-01	3.52E+00	2.70E+00	1.59E+00	1.74E+01	1.74E+01	2.34E-03	1.18E+00	2.98E+02	1.69E+00	1.70E+00
1.72E+01	3.69E-01	3.85E+00	2.85E+00	1.59E+00	2.03E+01	2.03E+01	1.96E-03	1.18E+00	2.98E+02	1.74E+00	1.75E+00
2.04E+01	4.47E-01	4.23E+00	3.03E+00	1.59E+00	2.38E+01	2.38E+01	1.63E-03	1.18E+00	2.98E+02	1.80E+00	1.81E+00
2.42E+01	5.36E-01	4.66E+00	3.25E+00	1.59E+00	2.79E+01	2.79E+01	1.33E-03	1.18E+00	2.98E+02	1.87E+00	1.87E+00
2.89E+01	6.35E-01	5.16E+00	3.51E+00	1.59E+00	3.29E+01	3.29E+01	1.08E-03	1.18E+00	2.98E+02	1.93E+00	1.94E+00
3.45E+01	7.46E-01	5.72E+00	3.82E+00	1.59E+00	3.90E+01	3.90E+01	8.62E-04	1.18E+00	2.98E+02	2.00E+00	2.00E+00
4.12E+01	8.67E-01	6.37E+00	4.19E+00	1.59E+00	4.63E+01	4.63E+01	6.81E-04	1.18E+00	2.98E+02	2.07E+00	2.07E+00
4.94E+01	9.98E-01	7.11E+00	4.65E+00	1.59E+00	5.50E+01	5.50E+01	5.33E-04	1.18E+00	2.98E+02	2.14E+00	2.14E+00
5.92E+01	1.14E+00	7.95E+00	5.19E+00	1.59E+00	6.56E+01	6.56E+01	4.12E-04	1.18E+00	2.98E+02	2.21E+00	2.21E+00
7.10E+01	1.29E+00	8.92E+00	5.84E+00	1.59E+00	7.84E+01	7.84E+01	3.16E-04	1.18E+00	2.98E+02	2.28E+00	2.29E+00
8.53E+01	1.45E+00	1.00E+01	6.63E+00	1.59E+00	9.37E+01	9.37E+01	2.40E-04	1.18E+00	2.98E+02	2.36E+00	2.36E+00
1.02E+02	1.61E+00	1.13E+01	7.57E+00	1.59E+00	1.12E+02	1.12E+02	1.81E-04	1.18E+00	2.98E+02	2.44E+00	2.44E+00
1.23E+02	1.78E+00	1.27E+01	8.71E+00	1.59E+00	1.35E+02	1.35E+02	1.35E-04	1.18E+00	2.98E+02	2.51E+00	2.51E+00
1.48E+02	1.95E+00	1.44E+01	1.01E+01	1.59E+00	1.61E+02	1.61E+02	1.00E-04	1.18E+00	2.98E+02	2.59E+00	2.59E+00
1.78E+02	2.13E+00	1.63E+01	1.17E+01	1.59E+00	1.94E+02	1.94E+02	7.39E-05	1.18E+00	2.98E+02	2.67E+00	2.67E+00
2.14E+02	2.31E+00	1.85E+01	1.37E+01	1.59E+00	2.33E+02	2.33E+02	5.43E-05	1.18E+00	2.98E+02	2.75E+00	2.75E+00
2.58E+02	2.50E+00	2.10E+01	1.60E+01	1.59E+00	2.80E+02	2.80E+02	3.96E-05	1.18E+00	2.98E+02	2.83E+00	2.83E+00
3.11E+02	2.68E+00	2.38E+01	1.88E+01	1.59E+00	3.37E+02	3.37E+02	2.89E-05	1.18E+00	2.98E+02	2.91E+00	2.92E+00
3.74E+02	2.87E+00	2.71E+01	2.21E+01	1.59E+00	4.05E+02	4.05E+02	2.10E-05	1.18E+00	2.98E+02	3.00E+00	3.00E+00
4.51E+02	3.05E+00	3.09E+01	2.61E+01	1.59E+00	4.88E+02	4.88E+02	1.52E-05	1.18E+00	2.98E+02	3.08E+00	3.08E+00
5.43E+02	3.24E+00	3.52E+01	3.08E+01	1.59E+00	5.87E+02	5.87E+02	1.10E-05	1.18E+00	2.98E+02	3.16E+00	3.17E+00
6.54E+02	3.42E+00	4.01E+01	3.64E+01	1.59E+00	7.07E+02	7.07E+02	7.93E-06	1.18E+00	2.98E+02	3.25E+00	3.25E+00
7.87E+02	3.61E+00	4.58E+01	4.30E+01	1.59E+00	8.51E+02	8.51E+02	5.73E-06	1.18E+00	2.98E+02	3.33E+00	3.33E+00
9.49E+02	3.79E+00	5.24E+01	5.08E+01	1.59E+00	1.03E+03	1.03E+03	4.14E-06	1.18E+00	2.98E+02	3.42E+00	3.42E+00
1.15E+03	3.98E+00	6.14E+01	6.01E+01	1.59E+00	1.06E+03	1.03E+03	2.88E-06	1.18E+00	2.98E+02	3.52E+00	3.52E+00
1.39E+03	4.15E+00	7.18E+01	7.13E+01	1.59E+00	1.11E+03	1.03E+03	1.99E-06	1.18E+00	2.98E+02	3.62E+00	3.62E+00
1.69E+03	4.32E+00	8.40E+01	8.47E+01	1.59E+00	1.16E+03	1.03E+03	1.36E-06	1.18E+00	2.98E+02	3.72E+00	3.72E+00
2.07E+03	4.48E+00	9.82E+01	1.01E+02	1.59E+00	1.23E+03	1.03E+03	9.30E-07	1.18E+00	2.98E+02	3.81E+00	3.82E+00

x	cm	cmv	cmda	cmw	cmwv	wc	vg	ug	w	v	vx
-1.77E+00	0.00E+00	0.00E+00	9.90E-01	1.03E-02	1.03E-02	0.00E+00	0.00E+00	0.00E+00	5.85E-01	9.76E-02	0.00E+00
-1.41E+00	4.05E-03	4.05E-03	9.86E-01	1.03E-02	1.03E-02	0.00E+00	0.00E+00	0.00E+00	3.73E-01	1.92E-02	2.35E-01
-1.06E+00	4.76E-03	4.76E-03	9.85E-01	1.03E-02	1.03E-02	0.00E+00	0.00E+00	0.00E+00	3.15E-01	2.40E-02	2.62E-01
-7.07E-01	5.20E-03	5.20E-03	9.85E-01	1.03E-02	1.03E-02	0.00E+00	0.00E+00	0.00E+00	2.88E-01	2.73E-02	2.78E-01
-3.54E-01	5.51E-03	5.51E-03	9.84E-01	1.03E-02	1.03E-02	0.00E+00	0.00E+00	0.00E+00	2.70E-01	2.97E-02	2.88E-01
1.04E-07	5.74E-03	5.74E-03	9.84E-01	1.02E-02	1.02E-02	0.00E+00	0.00E+00	0.00E+00	2.57E-01	3.17E-02	2.96E-01
3.54E-01	5.93E-03	5.93E-03	9.84E-01	1.02E-02	1.02E-02	0.00E+00	0.00E+00	0.00E+00	2.47E-01	3.34E-02	3.03E-01
7.07E-01	6.08E-03	6.08E-03	9.84E-01	1.02E-02	1.02E-02	0.00E+00	0.00E+00	0.00E+00	2.38E-01	3.50E-02	3.08E-01
1.06E+00	6.20E-03	6.20E-03	9.84E-01	1.02E-02	1.02E-02	0.00E+00	0.00E+00	0.00E+00	2.31E-01	3.63E-02	3.13E-01
1.41E+00	6.30E-03	6.30E-03	9.83E-01	1.02E-02	1.02E-02	0.00E+00	0.00E+00	0.00E+00	2.25E-01	3.75E-02	3.17E-01
1.77E+00	6.39E-03	6.39E-03	9.83E-01	1.02E-02	1.02E-02	2.10E-03	0.00E+00	0.00E+00	2.20E-01	3.87E-02	3.20E-01
1.80E+00	6.33E-03	6.33E-03	9.83E-01	1.02E-02	1.02E-02	2.73E-03	0.00E+00	0.00E+00	2.20E-01	3.88E-02	3.20E-01
1.85E+00	6.27E-03	6.27E-03	9.83E-01	1.02E-02	1.02E-02	3.47E-03	0.00E+00	0.00E+00	2.19E-01	3.89E-02	3.21E-01
1.90E+00	6.19E-03	6.19E-03	9.84E-01	1.02E-02	1.02E-02	4.35E-03	0.00E+00	0.00E+00	2.19E-01	3.90E-02	3.21E-01
1.96E+00	6.10E-03	6.10E-03	9.84E-01	1.02E-02	1.02E-02	5.37E-03	0.00E+00	0.00E+00	2.18E-01	3.92E-02	3.22E-01
2.04E+00	5.99E-03	5.99E-03	9.84E-01	1.02E-02	1.02E-02	6.55E-03	0.00E+00	0.00E+00	2.17E-01	3.94E-02	3.22E-01
2.13E+00	5.86E-03	5.86E-03	9.84E-01	1.02E-02	1.02E-02	7.92E-03	0.00E+00	0.00E+00	2.16E-01	3.96E-02	3.23E-01
2.24E+00	5.72E-03	5.72E-03	9.84E-01	1.02E-02	1.02E-02	9.49E-03	0.00E+00	0.00E+00	2.15E-01	3.98E-02	3.24E-01
2.38E+00	5.55E-03	5.55E-03	9.84E-01	1.03E-02	1.03E-02	1.13E-02	0.00E+00	0.00E+00	2.14E-01	4.01E-02	3.25E-01
2.54E+00	5.37E-03	5.37E-03	9.84E-01	1.03E-02	1.03E-02	1.33E-02	0.00E+00	0.00E+00	2.12E-01	4.05E-02	3.26E-01
2.73E+00	5.16E-03	5.16E-03	9.85E-01	1.03E-02	1.03E-02	1.55E-02	0.00E+00	0.00E+00	2.11E-01	4.09E-02	3.27E-01
2.97E+00	4.93E-03	4.93E-03	9.85E-01	1.03E-02	1.03E-02	1.79E-02	0.00E+00	0.00E+00	2.09E-01	4.13E-02	3.29E-01
3.25E+00	4.67E-03	4.67E-03	9.85E-01	1.03E-02	1.03E-02	2.05E-02	0.00E+00	0.00E+00	2.07E-01	4.19E-02	3.31E-01
3.59E+00	4.40E-03	4.40E-03	9.85E-01	1.03E-02	1.03E-02	2.33E-02	0.00E+00	0.00E+00	2.05E-01	4.25E-02	3.33E-01
4.00E+00	4.10E-03	4.10E-03	9.86E-01	1.03E-02	1.03E-02	2.62E-02	0.00E+00	0.00E+00	2.03E-01	4.33E-02	3.35E-01
4.50E+00	3.79E-03	3.79E-03	9.86E-01	1.03E-02	1.03E-02	2.91E-02	0.00E+00	0.00E+00	2.00E-01	4.41E-02	3.37E-01
5.09E+00	3.47E-03	3.47E-03	9.86E-01	1.03E-02	1.03E-02	3.19E-02	0.00E+00	0.00E+00	1.97E-01	4.50E-02	3.40E-01
5.81E+00	3.15E-03	3.15E-03	9.87E-01	1.03E-02	1.03E-02	3.47E-02	0.00E+00	0.00E+00	1.94E-01	4.61E-02	3.43E-01
6.68E+00	2.83E-03	2.83E-03	9.87E-01	1.03E-02	1.03E-02	3.72E-02	0.00E+00	0.00E+00	1.91E-01	4.72E-02	3.46E-01
7.72E+00	2.51E-03	2.51E-03	9.87E-01	1.03E-02	1.03E-02	3.94E-02	0.00E+00	0.00E+00	1.87E-01	4.85E-02	3.49E-01
8.98E+00	2.20E-03	2.20E-03	9.88E-01	1.03E-02	1.03E-02	4.13E-02	0.00E+00	0.00E+00	1.84E-01	4.99E-02	3.53E-01
1.05E+01	1.91E-03	1.91E-03	9.88E-01	1.03E-02	1.03E-02	4.26E-02	0.00E+00	0.00E+00	1.80E-01	5.14E-02	3.56E-01
1.23E+01	1.64E-03	1.64E-03	9.88E-01	1.03E-02	1.03E-02	4.35E-02	0.00E+00	0.00E+00	1.75E-01	5.30E-02	3.59E-01
1.45E+01	1.39E-03	1.39E-03	9.88E-01	1.03E-02	1.03E-02	4.38E-02	0.00E+00	0.00E+00	1.71E-01	5.47E-02	3.62E-01
1.72E+01	1.16E-03	1.16E-03	9.89E-01	1.03E-02	1.03E-02	4.36E-02	0.00E+00	0.00E+00	1.67E-01	5.64E-02	3.65E-01
2.04E+01	9.64E-04	9.64E-04	9.89E-01	1.03E-02	1.03E-02	4.29E-02	0.00E+00	0.00E+00	1.63E-01	5.83E-02	3.68E-01
2.42E+01	7.89E-04	7.89E-04	9.89E-01	1.03E-02	1.03E-02	4.16E-02	0.00E+00	0.00E+00	1.58E-01	6.02E-02	3.70E-01
2.89E+01	6.38E-04	6.38E-04	9.89E-01	1.03E-02	1.03E-02	3.98E-02	0.00E+00	0.00E+00	1.54E-01	6.22E-02	3.72E-01
3.45E+01	5.10E-04	5.10E-04	9.89E-01	1.03E-02	1.03E-02	3.77E-02	0.00E+00	0.00E+00	1.50E-01	6.43E-02	3.74E-01
4.12E+01	4.03E-04	4.03E-04	9.89E-01	1.03E-02	1.03E-02	3.53E-02	0.00E+00	0.00E+00	1.46E-01	6.64E-02	3.76E-01
4.94E+01	3.15E-04	3.15E-04	9.89E-01	1.03E-02	1.03E-02	3.26E-02	0.00E+00	0.00E+00	1.42E-01	6.85E-02	3.77E-01
5.92E+01	2.44E-04	2.44E-04	9.89E-01	1.03E-02	1.03E-02	2.99E-02	0.00E+00	0.00E+00	1.38E-01	7.07E-02	3.79E-01
7.10E+01	1.87E-04	1.87E-04	9.90E-01	1.03E-02	1.03E-02	2.70E-02	0.00E+00	0.00E+00	1.35E-01	7.28E-02	3.80E-01
8.53E+01	1.42E-04	1.42E-04	9.90E-01	1.03E-02	1.03E-02	2.43E-02	0.00E+00	0.00E+00	1.31E-01	7.50E-02	3.81E-01

1.02E+02 1.07E-04 1.07E-04 9.90E-01 1.03E-02 1.03E-02 2.16E-02 0.00E+00 0.00E+00 1.28E-01 7.72E-02 3.82E-01  
 1.23E+02 7.99E-05 7.99E-05 9.90E-01 1.03E-02 1.03E-02 1.91E-02 0.00E+00 0.00E+00 1.24E-01 7.93E-02 3.83E-01  
 1.48E+02 5.93E-05 5.93E-05 9.90E-01 1.03E-02 1.03E-02 1.67E-02 0.00E+00 0.00E+00 1.21E-01 8.14E-02 3.83E-01  
 1.78E+02 4.37E-05 4.37E-05 9.90E-01 1.03E-02 1.03E-02 1.46E-02 0.00E+00 0.00E+00 1.18E-01 8.35E-02 3.84E-01  
 2.14E+02 3.21E-05 3.21E-05 9.90E-01 1.03E-02 1.03E-02 1.26E-02 0.00E+00 0.00E+00 1.15E-01 8.54E-02 3.84E-01  
 2.58E+02 2.35E-05 2.35E-05 9.90E-01 1.03E-02 1.03E-02 1.09E-02 0.00E+00 0.00E+00 1.12E-01 8.72E-02 3.85E-01  
 3.11E+02 1.71E-05 1.71E-05 9.90E-01 1.03E-02 1.03E-02 9.36E-03 0.00E+00 0.00E+00 1.09E-01 8.89E-02 3.85E-01  
 3.74E+02 1.24E-05 1.24E-05 9.90E-01 1.03E-02 1.03E-02 8.00E-03 0.00E+00 0.00E+00 1.06E-01 9.04E-02 3.85E-01  
 4.51E+02 8.98E-06 8.98E-06 9.90E-01 1.03E-02 1.03E-02 6.84E-03 0.00E+00 0.00E+00 1.03E-01 9.18E-02 3.85E-01  
 5.43E+02 6.50E-06 6.50E-06 9.90E-01 1.03E-02 1.03E-02 5.84E-03 0.00E+00 0.00E+00 1.01E-01 9.28E-02 3.85E-01  
 6.54E+02 4.69E-06 4.69E-06 9.90E-01 1.03E-02 1.03E-02 4.97E-03 0.00E+00 0.00E+00 9.79E-02 9.36E-02 3.85E-01  
 7.87E+02 3.39E-06 3.39E-06 9.90E-01 1.03E-02 1.03E-02 4.23E-03 0.00E+00 0.00E+00 9.53E-02 9.41E-02 3.84E-01  
 9.49E+02 2.45E-06 2.45E-06 9.90E-01 1.03E-02 1.03E-02 3.54E-03 0.00E+00 0.00E+00 9.27E-02 9.42E-02 3.84E-01  
 1.15E+03 1.70E-06 1.70E-06 9.90E-01 1.03E-02 1.03E-02 2.88E-03 0.00E+00 0.00E+00 8.97E-02 9.44E-02 3.83E-01  
 1.39E+03 1.18E-06 1.18E-06 9.90E-01 1.03E-02 1.03E-02 2.31E-03 0.00E+00 0.00E+00 8.68E-02 9.40E-02 3.82E-01  
 1.69E+03 8.07E-07 8.07E-07 9.90E-01 1.03E-02 1.03E-02 1.86E-03 0.00E+00 0.00E+00 8.38E-02 9.30E-02 3.81E-01  
 2.07E+03 5.51E-07 5.51E-07 9.90E-01 1.03E-02 1.03E-02 1.44E-03 0.00E+00 0.00E+00 8.09E-02 9.14E-02 3.79E-01

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time averaged (tav = 3600. s) volume concentration: concentration contour parameters

$$c(x,y,z,t) = cc(x) * (\text{erf}(xa) - \text{erf}(xb)) * (\text{erf}(ya) - \text{erf}(yb)) * (\exp(-za*za) + \exp(-zb*zb))$$

$c(x,y,z,t)$  = concentration (volume fraction) at  $(x,y,z,t)$

$x$  = downwind distance (m)

$y$  = crosswind horizontal distance (m)

$z$  = height (m)

$t$  = time (s)

$\text{erf}$  = error function

$xa = (x-xc+bx)/(sr2*\betaax)$

$xb = (x-xc-bx)/(sr2*\betaax)$

$ya = (y+b)/(sr2*\betaac)$

$yb = (y-b)/(sr2*\betaac)$

$\exp$  = exponential function

$za = (z-zc)/(sr2*\sigma)$

$zb = (z+zc)/(sr2*\sigma)$

$sr2 = \sqrt{2.0}$

$x$	$cc(x)$	$b(x)$	$\betaac(x)$	$zc(x)$	$\sigma(x)$	$t$	$xc(t)$	$bx(t)$	$\betaax(t)$
-1.77E+00	0.00E+00	1.59E+00	4.45E-01	0.00E+00	0.00E+00			1.08E+00	0.00E+00
-1.41E+00	1.33E-03	1.59E+00	4.81E-01	0.00E+00	3.00E-01			1.28E+00	1.77E-01
-1.06E+00	1.58E-03	1.59E+00	5.07E-01	0.00E+00	4.04E-01			1.47E+00	3.54E-01
-7.07E-01	1.75E-03	1.59E+00	5.33E-01	0.00E+00	4.86E-01			1.70E+00	5.30E-01
-3.54E-01	1.88E-03	1.59E+00	5.59E-01	0.00E+00	5.58E-01			1.92E+00	7.07E-01
1.04E-07	1.98E-03	1.59E+00	5.86E-01	0.00E+00	6.22E-01			2.17E+00	8.84E-01

3.54E-01	2.07E-03	1.59E+00	6.12E-01	0.00E+00	6.82E-01	2.42E+00	1.06E+00	2.91E+00	2.38E-02
7.07E-01	2.15E-03	1.59E+00	6.38E-01	0.00E+00	7.38E-01	2.69E+00	1.24E+00	3.10E+00	2.53E-02
1.06E+00	2.23E-03	1.59E+00	6.65E-01	0.00E+00	7.91E-01	2.96E+00	1.41E+00	3.29E+00	2.69E-02
1.41E+00	2.29E-03	1.59E+00	6.92E-01	0.00E+00	8.42E-01	3.26E+00	1.59E+00	3.48E+00	2.84E-02
1.77E+00	2.36E-03	1.59E+00	7.18E-01	3.61E-05	8.91E-01	3.56E+00	1.77E+00	3.67E+00	3.00E-02
1.80E+00	2.34E-03	1.59E+00	7.21E-01	1.13E-04	8.97E-01	3.62E+00	1.80E+00	3.71E+00	3.03E-02
1.85E+00	2.32E-03	1.59E+00	7.24E-01	2.31E-04	9.02E-01	3.70E+00	1.85E+00	3.76E+00	3.07E-02
1.90E+00	2.30E-03	1.59E+00	7.28E-01	4.10E-04	9.08E-01	3.79E+00	1.90E+00	3.82E+00	3.12E-02
1.96E+00	2.27E-03	1.59E+00	7.33E-01	6.77E-04	9.16E-01	3.90E+00	1.96E+00	3.89E+00	3.17E-02
2.04E+00	2.24E-03	1.59E+00	7.39E-01	1.07E-03	9.24E-01	4.03E+00	2.04E+00	3.97E+00	3.24E-02
2.13E+00	2.20E-03	1.59E+00	7.46E-01	1.64E-03	9.35E-01	4.19E+00	2.13E+00	4.07E+00	3.32E-02
2.24E+00	2.15E-03	1.59E+00	7.54E-01	2.46E-03	9.47E-01	4.38E+00	2.24E+00	4.19E+00	3.42E-02
2.38E+00	2.11E-03	1.59E+00	7.64E-01	3.63E-03	9.61E-01	4.60E+00	2.38E+00	4.33E+00	3.54E-02
2.54E+00	2.05E-03	1.59E+00	7.76E-01	5.29E-03	9.79E-01	4.87E+00	2.54E+00	4.51E+00	3.68E-02
2.73E+00	1.99E-03	1.59E+00	7.91E-01	7.59E-03	9.99E-01	5.19E+00	2.73E+00	4.72E+00	3.85E-02
2.97E+00	1.92E-03	1.59E+00	8.08E-01	1.08E-02	1.02E+00	5.57E+00	2.97E+00	4.97E+00	4.06E-02
3.25E+00	1.85E-03	1.59E+00	8.29E-01	1.51E-02	1.05E+00	6.03E+00	3.25E+00	5.27E+00	4.31E-02
3.59E+00	1.77E-03	1.59E+00	8.55E-01	2.10E-02	1.08E+00	6.56E+00	3.59E+00	5.64E+00	4.61E-02
4.00E+00	1.68E-03	1.59E+00	8.85E-01	2.89E-02	1.12E+00	7.20E+00	4.00E+00	6.09E+00	4.97E-02
4.50E+00	1.60E-03	1.59E+00	9.22E-01	3.92E-02	1.17E+00	7.94E+00	4.50E+00	6.62E+00	5.41E-02
5.09E+00	1.50E-03	1.59E+00	9.66E-01	5.27E-02	1.22E+00	8.83E+00	5.09E+00	7.26E+00	5.93E-02
5.81E+00	1.41E-03	1.59E+00	1.02E+00	7.00E-02	1.28E+00	9.86E+00	5.81E+00	8.04E+00	6.56E-02
6.68E+00	1.32E-03	1.59E+00	1.08E+00	9.19E-02	1.34E+00	1.11E+01	6.68E+00	8.97E+00	7.33E-02
7.72E+00	1.23E-03	1.59E+00	1.16E+00	1.19E-01	1.42E+00	1.25E+01	7.72E+00	1.01E+01	8.25E-02
8.98E+00	1.15E-03	1.59E+00	1.25E+00	1.53E-01	1.51E+00	1.42E+01	8.98E+00	1.15E+01	9.36E-02
1.05E+01	1.07E-03	1.59E+00	1.36E+00	1.94E-01	1.61E+00	1.61E+01	1.05E+01	1.31E+01	1.07E-01
1.23E+01	9.88E-04	1.59E+00	1.50E+00	2.43E-01	1.73E+00	1.84E+01	1.23E+01	1.51E+01	1.23E-01
1.45E+01	9.14E-04	1.59E+00	1.66E+00	3.01E-01	1.86E+00	2.11E+01	1.45E+01	1.74E+01	1.42E-01
1.72E+01	8.46E-04	1.59E+00	1.85E+00	3.69E-01	2.01E+00	2.41E+01	1.72E+01	2.03E+01	1.66E-01
2.04E+01	7.81E-04	1.59E+00	2.09E+00	4.47E-01	2.18E+00	2.78E+01	2.04E+01	2.38E+01	1.94E-01
2.42E+01	7.20E-04	1.59E+00	2.37E+00	5.36E-01	2.38E+00	3.20E+01	2.42E+01	2.79E+01	2.28E-01
2.89E+01	6.62E-04	1.59E+00	2.71E+00	6.35E-01	2.61E+00	3.69E+01	2.89E+01	3.29E+01	2.69E-01
3.45E+01	6.07E-04	1.59E+00	3.12E+00	7.46E-01	2.87E+00	4.26E+01	3.45E+01	3.90E+01	3.18E-01
4.12E+01	5.53E-04	1.59E+00	3.61E+00	8.67E-01	3.18E+00	4.92E+01	4.12E+01	4.63E+01	3.78E-01
4.94E+01	5.02E-04	1.59E+00	4.21E+00	9.98E-01	3.53E+00	5.69E+01	4.94E+01	5.50E+01	4.49E-01
5.92E+01	4.54E-04	1.59E+00	4.92E+00	1.14E+00	3.93E+00	6.59E+01	5.92E+01	6.56E+01	5.36E-01
7.10E+01	4.07E-04	1.59E+00	5.78E+00	1.29E+00	4.41E+00	7.65E+01	7.10E+01	7.84E+01	6.40E-01
8.53E+01	3.63E-04	1.59E+00	6.82E+00	1.45E+00	4.95E+00	8.87E+01	8.53E+01	9.37E+01	7.65E-01
1.02E+02	3.22E-04	1.59E+00	8.06E+00	1.61E+00	5.59E+00	1.03E+02	1.02E+02	1.12E+02	9.17E-01
1.23E+02	2.83E-04	1.59E+00	9.55E+00	1.78E+00	6.33E+00	1.20E+02	1.23E+02	1.35E+02	1.10E+00
1.48E+02	2.48E-04	1.59E+00	1.13E+01	1.95E+00	7.18E+00	1.39E+02	1.48E+02	1.61E+02	1.32E+00
1.78E+02	2.16E-04	1.59E+00	1.35E+01	2.13E+00	8.18E+00	1.62E+02	1.78E+02	1.94E+02	1.58E+00
2.14E+02	1.88E-04	1.59E+00	1.61E+01	2.31E+00	9.33E+00	1.89E+02	2.14E+02	2.33E+02	1.90E+00
2.58E+02	1.62E-04	1.59E+00	1.91E+01	2.50E+00	1.07E+01	2.20E+02	2.58E+02	2.80E+02	2.29E+00
3.11E+02	1.40E-04	1.59E+00	2.28E+01	2.68E+00	1.22E+01	2.57E+02	3.11E+02	3.37E+02	2.75E+00
3.74E+02	1.20E-04	1.59E+00	2.72E+01	2.87E+00	1.40E+01	3.00E+02	3.74E+02	4.05E+02	3.31E+00

4.51E+02	1.03E-04	1.59E+00	3.24E+01	3.05E+00	1.61E+01	3.50E+02	4.51E+02	4.88E+02	3.98E+00
5.43E+02	8.78E-05	1.59E+00	3.86E+01	3.24E+00	1.84E+01	4.09E+02	5.43E+02	5.87E+02	4.79E+00
6.54E+02	7.50E-05	1.59E+00	4.60E+01	3.42E+00	2.12E+01	4.78E+02	6.54E+02	7.07E+02	5.77E+00
7.87E+02	6.39E-05	1.59E+00	5.46E+01	3.61E+00	2.44E+01	5.60E+02	7.87E+02	8.51E+02	6.95E+00
9.49E+02	5.45E-05	1.59E+00	6.49E+01	3.79E+00	2.81E+01	6.55E+02	9.49E+02	1.03E+03	8.37E+00
1.15E+03	4.64E-05	1.59E+00	7.72E+01	3.98E+00	3.31E+01	6.57E+02	1.15E+03	1.03E+03	1.62E+02
1.39E+03	3.96E-05	1.59E+00	9.22E+01	4.15E+00	3.91E+01	7.25E+02	1.39E+03	1.03E+03	2.43E+02
1.69E+03	3.39E-05	1.59E+00	1.10E+02	4.32E+00	4.60E+01	8.08E+02	1.69E+03	1.03E+03	3.17E+02
2.07E+03	2.90E-05	1.59E+00	1.32E+02	4.48E+00	5.41E+01	9.08E+02	2.07E+03	1.03E+03	3.91E+02

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time averaged (tav = 3600. s) volume concentration: concentration in the z = 1.50 plane.

downwind distance x (m)	time of max conc (s)	cloud duration (s)	effective bbc (m)	average concentration (volume fraction) at (x,y,z)						
				y/bbc= 0.0	y/bbc= 0.5	y/bbc= 1.0	y/bbc= 1.5	y/bbc= 2.0	y/bbc= 2.5	
-1.77E+00	3.01E+02	6.00E+02	1.77E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
-1.41E+00	3.00E+02	6.00E+02	1.80E+00	6.73E-09	6.23E-09	2.26E-09	7.35E-11	1.07E-13	0.00E+00	
-1.06E+00	3.00E+02	6.00E+02	1.82E+00	2.16E-06	1.97E-06	7.11E-07	2.73E-08	6.02E-11	0.00E+00	
-7.07E-01	3.00E+02	6.00E+02	1.84E+00	2.00E-05	1.80E-05	6.42E-06	2.85E-07	8.97E-10	0.00E+00	
-3.54E-01	3.00E+02	6.00E+02	1.86E+00	6.66E-05	5.89E-05	2.10E-05	1.05E-06	4.52E-09	1.99E-12	
1.04E-07	3.00E+02	6.00E+02	1.89E+00	1.42E-04	1.24E-04	4.40E-05	2.46E-06	1.39E-08	8.54E-12	
3.54E-01	3.00E+02	6.00E+02	1.91E+00	2.41E-04	2.07E-04	7.30E-05	4.50E-06	3.21E-08	2.18E-11	
7.07E-01	3.00E+02	6.00E+02	1.94E+00	3.55E-04	3.00E-04	1.05E-04	7.07E-06	6.21E-08	6.42E-11	
1.06E+00	3.00E+02	6.00E+02	1.96E+00	4.76E-04	3.97E-04	1.39E-04	1.01E-05	1.06E-07	1.44E-10	
1.41E+00	3.00E+02	6.00E+02	1.99E+00	6.02E-04	4.95E-04	1.73E-04	1.34E-05	1.67E-07	2.93E-10	
1.77E+00	3.01E+02	6.00E+02	2.02E+00	7.26E-04	5.90E-04	2.06E-04	1.69E-05	2.43E-07	5.56E-10	
1.80E+00	3.01E+02	6.00E+02	2.02E+00	7.34E-04	5.96E-04	2.07E-04	1.71E-05	2.50E-07	5.85E-10	
1.85E+00	3.01E+02	6.00E+02	2.03E+00	7.39E-04	5.98E-04	2.08E-04	1.73E-05	2.57E-07	6.11E-10	
1.90E+00	3.01E+02	6.00E+02	2.03E+00	7.44E-04	6.01E-04	2.09E-04	1.75E-05	2.66E-07	6.62E-10	
1.96E+00	3.01E+02	6.00E+02	2.04E+00	7.49E-04	6.05E-04	2.10E-04	1.78E-05	2.76E-07	7.14E-10	
2.04E+00	3.01E+02	6.00E+02	2.04E+00	7.56E-04	6.08E-04	2.11E-04	1.81E-05	2.89E-07	7.67E-10	
2.13E+00	3.01E+02	6.00E+02	2.05E+00	7.63E-04	6.12E-04	2.13E-04	1.84E-05	3.04E-07	8.46E-10	
2.24E+00	3.01E+02	6.00E+02	2.06E+00	7.71E-04	6.16E-04	2.14E-04	1.88E-05	3.23E-07	9.76E-10	
2.38E+00	3.01E+02	6.00E+02	2.07E+00	7.79E-04	6.20E-04	2.15E-04	1.93E-05	3.45E-07	1.11E-09	
2.54E+00	3.01E+02	6.00E+02	2.08E+00	7.87E-04	6.24E-04	2.16E-04	1.98E-05	3.73E-07	1.30E-09	
2.73E+00	3.01E+02	6.00E+02	2.10E+00	7.96E-04	6.27E-04	2.17E-04	2.03E-05	4.05E-07	1.56E-09	
2.97E+00	3.01E+02	6.00E+02	2.12E+00	8.03E-04	6.29E-04	2.17E-04	2.09E-05	4.45E-07	1.89E-09	
3.25E+00	3.01E+02	6.00E+02	2.14E+00	8.09E-04	6.28E-04	2.16E-04	2.15E-05	4.92E-07	2.37E-09	
3.59E+00	3.01E+02	6.00E+02	2.17E+00	8.13E-04	6.26E-04	2.15E-04	2.21E-05	5.48E-07	3.00E-09	
4.00E+00	3.01E+02	6.00E+02	2.21E+00	8.12E-04	6.19E-04	2.12E-04	2.26E-05	6.12E-07	3.89E-09	
4.50E+00	3.01E+02	6.00E+02	2.25E+00	8.07E-04	6.09E-04	2.08E-04	2.30E-05	6.84E-07	5.04E-09	
5.09E+00	3.02E+02	6.00E+02	2.31E+00	7.95E-04	5.93E-04	2.02E-04	2.32E-05	7.62E-07	6.63E-09	
5.81E+00	3.02E+02	6.00E+02	2.38E+00	7.75E-04	5.72E-04	1.94E-04	2.32E-05	8.43E-07	8.64E-09	
6.68E+00	3.02E+02	6.00E+02	2.46E+00	7.46E-04	5.44E-04	1.84E-04	2.29E-05	9.20E-07	1.11E-08	

7.72E+00	3.02E+02	6.00E+02	2.56E+00	7.08E-04	5.11E-04	1.71E-04	2.22E-05	9.85E-07	1.40E-08
8.98E+00	3.03E+02	6.00E+02	2.69E+00	6.61E-04	4.72E-04	1.58E-04	2.12E-05	1.03E-06	1.72E-08
1.05E+01	3.03E+02	6.00E+02	2.85E+00	6.05E-04	4.28E-04	1.42E-04	1.97E-05	1.04E-06	2.01E-08
1.23E+01	3.04E+02	6.00E+02	3.04E+00	5.44E-04	3.81E-04	1.26E-04	1.80E-05	1.03E-06	2.25E-08
1.45E+01	3.05E+02	6.00E+02	3.28E+00	4.78E-04	3.33E-04	1.10E-04	1.60E-05	9.71E-07	2.38E-08
1.72E+01	3.05E+02	6.00E+02	3.58E+00	4.11E-04	2.85E-04	9.34E-05	1.38E-05	8.86E-07	2.38E-08
2.04E+01	3.06E+02	6.00E+02	3.95E+00	3.45E-04	2.39E-04	7.81E-05	1.17E-05	7.80E-07	2.25E-08
2.42E+01	3.08E+02	6.00E+02	4.40E+00	2.84E-04	1.96E-04	6.40E-05	9.67E-06	6.64E-07	2.03E-08
2.89E+01	3.09E+02	6.00E+02	4.96E+00	2.30E-04	1.58E-04	5.15E-05	7.83E-06	5.48E-07	1.74E-08
3.45E+01	3.11E+02	6.00E+02	5.63E+00	1.82E-04	1.25E-04	4.07E-05	6.21E-06	4.41E-07	1.44E-08
4.12E+01	3.13E+02	6.00E+02	6.46E+00	1.42E-04	9.74E-05	3.16E-05	4.84E-06	3.46E-07	1.15E-08
4.94E+01	3.16E+02	6.00E+02	7.46E+00	1.09E-04	7.47E-05	2.43E-05	3.71E-06	2.67E-07	9.00E-09
5.92E+01	3.19E+02	6.00E+02	8.67E+00	8.22E-05	5.65E-05	1.84E-05	2.81E-06	2.03E-07	6.89E-09
7.10E+01	3.22E+02	6.00E+02	1.01E+01	6.16E-05	4.23E-05	1.37E-05	2.11E-06	1.52E-07	5.19E-09
8.53E+01	3.27E+02	6.00E+02	1.19E+01	4.57E-05	3.14E-05	1.02E-05	1.56E-06	1.13E-07	3.86E-09
1.02E+02	3.32E+02	6.00E+02	1.40E+01	3.36E-05	2.31E-05	7.49E-06	1.15E-06	8.32E-08	2.84E-09
1.23E+02	3.39E+02	6.00E+02	1.66E+01	2.45E-05	1.69E-05	5.47E-06	8.39E-07	6.08E-08	2.08E-09
1.48E+02	3.47E+02	6.00E+02	1.97E+01	1.78E-05	1.22E-05	3.97E-06	6.09E-07	4.41E-08	1.51E-09
1.78E+02	3.56E+02	6.00E+02	2.34E+01	1.29E-05	8.85E-06	2.87E-06	4.41E-07	3.19E-08	1.09E-09
2.14E+02	3.68E+02	6.00E+02	2.78E+01	9.27E-06	6.37E-06	2.07E-06	3.17E-07	2.30E-08	7.84E-10
2.58E+02	3.82E+02	6.00E+02	3.32E+01	6.66E-06	4.58E-06	1.49E-06	2.28E-07	1.65E-08	5.66E-10
3.11E+02	3.98E+02	6.00E+02	3.95E+01	4.77E-06	3.28E-06	1.06E-06	1.63E-07	1.18E-08	4.04E-10
3.74E+02	4.18E+02	6.00E+02	4.71E+01	3.41E-06	2.34E-06	7.61E-07	1.17E-07	8.45E-09	2.90E-10
4.51E+02	4.42E+02	6.00E+02	5.61E+01	2.44E-06	1.67E-06	5.44E-07	8.34E-08	6.04E-09	2.08E-10
5.43E+02	4.72E+02	6.00E+02	6.69E+01	1.74E-06	1.20E-06	3.88E-07	5.95E-08	4.31E-09	1.48E-10
6.54E+02	5.07E+02	6.00E+02	7.96E+01	1.24E-06	8.54E-07	2.77E-07	4.25E-08	3.08E-09	1.05E-10
7.87E+02	5.49E+02	6.00E+02	9.47E+01	8.88E-07	6.10E-07	1.98E-07	3.04E-08	2.20E-09	7.52E-11
9.49E+02	6.00E+02	6.00E+02	1.12E+02	6.35E-07	4.37E-07	1.42E-07	2.17E-08	1.58E-09	5.42E-11
1.15E+03	6.57E+02	6.04E+02	1.34E+02	4.40E-07	3.02E-07	9.82E-08	1.51E-08	1.09E-09	3.75E-11
1.39E+03	7.25E+02	6.13E+02	1.60E+02	3.04E-07	2.09E-07	6.79E-08	1.04E-08	7.55E-10	2.57E-11
1.69E+03	8.08E+02	6.26E+02	1.91E+02	2.11E-07	1.45E-07	4.70E-08	7.21E-09	5.22E-10	1.80E-11
2.07E+03	9.08E+02	6.44E+02	2.29E+02	1.46E-07	1.00E-07	3.25E-08	4.99E-09	3.62E-10	1.22E-11

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time averaged (tav = 3600. s) volume concentration: maximum concentration (volume fraction) along centerline.

downwind distance	maximum height	time of cloud	concentration	max conc	duration
x (m)	z (m)	c(x,0,z)	(s)	(s)	
-1.77E+00	0.00E+00	0.00E+00	3.01E+02	6.00E+02	
-1.41E+00	0.00E+00	1.77E-03	3.00E+02	6.00E+02	
-1.06E+00	0.00E+00	2.10E-03	3.00E+02	6.00E+02	
-7.07E-01	0.00E+00	2.32E-03	3.00E+02	6.00E+02	
-3.54E-01	0.00E+00	2.48E-03	3.00E+02	6.00E+02	
1.04E-07	0.00E+00	2.61E-03	3.00E+02	6.00E+02	

3.54E-01	0.00E+00	2.71E-03	3.00E+02	6.00E+02
7.07E-01	0.00E+00	2.80E-03	3.00E+02	6.00E+02
1.06E+00	0.00E+00	2.88E-03	3.00E+02	6.00E+02
1.41E+00	0.00E+00	2.94E-03	3.00E+02	6.00E+02
1.77E+00	0.00E+00	3.00E-03	3.01E+02	6.00E+02
1.80E+00	0.00E+00	2.97E-03	3.01E+02	6.00E+02
1.85E+00	0.00E+00	2.94E-03	3.01E+02	6.00E+02
1.90E+00	0.00E+00	2.91E-03	3.01E+02	6.00E+02
1.96E+00	0.00E+00	2.87E-03	3.01E+02	6.00E+02
2.04E+00	0.00E+00	2.82E-03	3.01E+02	6.00E+02
2.13E+00	0.00E+00	2.77E-03	3.01E+02	6.00E+02
2.24E+00	0.00E+00	2.70E-03	3.01E+02	6.00E+02
2.38E+00	0.00E+00	2.63E-03	3.01E+02	6.00E+02
2.54E+00	0.00E+00	2.55E-03	3.01E+02	6.00E+02
2.73E+00	0.00E+00	2.46E-03	3.01E+02	6.00E+02
2.97E+00	0.00E+00	2.35E-03	3.01E+02	6.00E+02
3.25E+00	0.00E+00	2.24E-03	3.01E+02	6.00E+02
3.59E+00	0.00E+00	2.12E-03	3.01E+02	6.00E+02
4.00E+00	0.00E+00	1.99E-03	3.01E+02	6.00E+02
4.50E+00	0.00E+00	1.84E-03	3.01E+02	6.00E+02
5.09E+00	0.00E+00	1.70E-03	3.02E+02	6.00E+02
5.81E+00	0.00E+00	1.54E-03	3.02E+02	6.00E+02
6.68E+00	0.00E+00	1.39E-03	3.02E+02	6.00E+02
7.72E+00	0.00E+00	1.23E-03	3.02E+02	6.00E+02
8.98E+00	0.00E+00	1.08E-03	3.03E+02	6.00E+02
1.05E+01	0.00E+00	9.28E-04	3.03E+02	6.00E+02
1.23E+01	0.00E+00	7.87E-04	3.04E+02	6.00E+02
1.45E+01	0.00E+00	6.56E-04	3.05E+02	6.00E+02
1.72E+01	0.00E+00	5.37E-04	3.05E+02	6.00E+02
2.04E+01	0.00E+00	4.33E-04	3.06E+02	6.00E+02
2.42E+01	0.00E+00	3.43E-04	3.08E+02	6.00E+02
2.89E+01	0.00E+00	2.68E-04	3.09E+02	6.00E+02
3.45E+01	0.00E+00	2.06E-04	3.11E+02	6.00E+02
4.12E+01	0.00E+00	1.57E-04	3.13E+02	6.00E+02
4.94E+01	0.00E+00	1.18E-04	3.16E+02	6.00E+02
5.92E+01	0.00E+00	8.79E-05	3.19E+02	6.00E+02
7.10E+01	0.00E+00	6.49E-05	3.22E+02	6.00E+02
8.53E+01	0.00E+00	4.76E-05	3.27E+02	6.00E+02
1.02E+02	0.00E+00	3.47E-05	3.32E+02	6.00E+02
1.23E+02	0.00E+00	2.52E-05	3.39E+02	6.00E+02
1.48E+02	0.00E+00	1.82E-05	3.47E+02	6.00E+02
1.78E+02	0.00E+00	1.31E-05	3.56E+02	6.00E+02
2.14E+02	0.00E+00	9.39E-06	3.68E+02	6.00E+02
2.58E+02	0.00E+00	6.72E-06	3.82E+02	6.00E+02
3.11E+02	0.00E+00	4.80E-06	3.98E+02	6.00E+02
3.74E+02	0.00E+00	3.43E-06	4.18E+02	6.00E+02

4.51E+02	0.00E+00	2.45E-06	4.42E+02	6.00E+02
5.43E+02	0.00E+00	1.75E-06	4.72E+02	6.00E+02
6.54E+02	0.00E+00	1.25E-06	5.07E+02	6.00E+02
7.87E+02	0.00E+00	8.90E-07	5.49E+02	6.00E+02
9.49E+02	0.00E+00	6.36E-07	6.00E+02	6.00E+02
1.15E+03	0.00E+00	4.41E-07	6.57E+02	6.04E+02
1.39E+03	0.00E+00	3.05E-07	7.25E+02	6.13E+02
1.69E+03	0.00E+00	2.11E-07	8.08E+02	6.26E+02
2.07E+03	0.00E+00	1.46E-07	9.08E+02	6.44E+02

```
*****
***      BEE-LINE SOFTWARE      ***
***      SLAB VERSION 5.0      ***
**      COPYRIGHT (C) 1997-98    **
*****
```

#### SESSION INFORMATION

INPUT DATA FILE NAME : C:\CALPINE\IEEC\NH3HOSE.SLB  
OUTPUT LIST FILE NAME : C:\CALPINE\IEEC\NH3HOSE.LST

problem input

```
idspl =      1
ncalc =      1
wms  =  0.017031
cps  =  2093.65
tbp  =  239.70
cmed0 =  0.83
dhe  = 1370837.
cpsl =  4956.39
rhosl =  639.00
spb  = 2132.50
spc  = -32.98
ts   =  310.72
qs   =  0.05
as   =  12.50
tsd  =  600.
qtis =  0.00
hs   =  0.00
tav  = 1800.00
xffm = 2000.00
zp(1) =  1.50
zp(2) =  0.00
zp(3) =  0.00
zp(4) =  0.00
z0   = 0.100000
za   =  10.00
```

ua = 3.00  
ta = 298.16  
rh = 50.00  
stab = 4.00

#### release gas properties

molecular weight of source gas (kg)	- wms = 1.7031E-02
vapor heat capacity, const. p. (j/kg-k)	- cps = 2.0936E+03
temperature of source gas (k)	- ts = 2.3970E+02
density of source gas (kg/m3)	- rhos = 8.6589E-01
boiling point temperature	- tbp = 2.3970E+02
liquid mass fraction	- cmed0= 0.0000E+00
liquid heat capacity (j/kg-k)	- cpsl = 4.9564E+03
heat of vaporization (j/kg)	- dhe = 1.3708E+06
liquid source density (kg/m3)	- rhosl= 6.3900E+02
saturation pressure constant	- spa = 1.0316E+01
saturation pressure constant (k)	- spb = 2.1325E+03
saturation pressure constant (k)	- spc = -3.2980E+01

#### spill characteristics

spill type	- idspl= 1
mass source rate (kg/s)	- qs = 5.2400E-02
continuous source duration (s)	- tsd = 6.0000E+02
continuous source mass (kg)	- qtcs = 3.1440E+01
instantaneous source mass (kg)	- qtis = 0.0000E+00
source area (m2)	- as = 1.2500E+01
vertical vapor velocity (m/s)	- ws = 4.8413E-03
source half width (m)	- bs = 1.7678E+00
source height (m)	- hs = 0.0000E+00
horizontal vapor velocity (m/s)	- us = 0.0000E+00

#### field parameters

concentration averaging time (s)	- tav = 1.8000E+03
mixing layer height (m)	- hmx = 1.0400E+03
maximum downwind distrace (m)	- xffm = 2.0000E+03
concentration measurement height (m)	- zp(1)= 1.5000E+00
	- zp(2)= 0.0000E+00
	- zp(3)= 0.0000E+00
	- zp(4)= 0.0000E+00

### ambient meteorological properties

molecular weight of ambient air (kg)	- wmae = 2.8780E-02
heat capacity of ambient air at const p. (j/kg-k)- cpaa	= 1.0145E+03
density of ambient air (kg/m3)	- rhoa = 1.1763E+00
ambient measurement height (m)	- za = 1.0000E+01
ambient atmospheric pressure (pa=n/m2=j/m3)	- pa = 1.0133E+05
ambient wind speed (m/s)	- ua = 3.0000E+00
ambient temperature (k)	- ta = 2.9816E+02
relative humidity (percent)	- rh = 5.0000E+01
ambient friction velocity (m/s)	- uastr = 2.6764E-01
atmospheric stability class value	- stab = 4.0000E+00
inverse monin-obukhov length (1/m)	- ala = 0.0000E+00
surface roughness height (m)	- z0 = 1.0000E-01

additional parameters

```

sub-step multiplier           - ncalc =      1
number of calculational sub-steps - nssm =      3
acceleration of gravity (m/s2) - grav = 9.8067E+00
gas constant (j/mol· k)        - rr   = 8.3143E+00
von karman constant          - xk   = 4.1000E-01
1

```

instantaneous spatially averaged cloud parameters

1.06E+00 0.00E+00 1.37E+00 1.94E+00 1.59E+00 3.29E+00 3.29E+00 1.04E-02 1.17E+00 2.97E+02  
 1.08E+00 1.12E+00  
 1.41E+00 0.00E+00 1.46E+00 1.96E+00 1.59E+00 3.48E+00 3.48E+00 1.06E-02 1.17E+00 2.97E+02  
 1.12E+00 1.16E+00  
 1.77E+00 3.61E-05 1.54E+00 1.98E+00 1.59E+00 3.67E+00 3.67E+00 1.08E-02 1.17E+00 2.97E+02  
 1.14E+00 1.19E+00  
 1.80E+00 1.13E-04 1.55E+00 1.98E+00 1.59E+00 3.71E+00 3.71E+00 1.07E-02 1.17E+00 2.97E+02  
 1.14E+00 1.19E+00  
 1.85E+00 2.31E-04 1.56E+00 1.98E+00 1.59E+00 3.76E+00 3.76E+00 1.05E-02 1.17E+00 2.97E+02  
 1.15E+00 1.20E+00  
 1.90E+00 4.10E-04 1.57E+00 1.99E+00 1.59E+00 3.82E+00 3.82E+00 1.04E-02 1.17E+00 2.97E+02  
 1.15E+00 1.20E+00  
 1.96E+00 6.77E-04 1.59E+00 1.99E+00 1.59E+00 3.89E+00 3.89E+00 1.03E-02 1.17E+00 2.98E+02  
 1.16E+00 1.21E+00  
 2.04E+00 1.07E-03 1.60E+00 1.99E+00 1.59E+00 3.97E+00 3.97E+00 1.01E-02 1.17E+00 2.98E+02  
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 2.13E+00 1.64E-03 1.62E+00 2.00E+00 1.59E+00 4.07E+00 4.07E+00 9.87E-03 1.17E+00 2.98E+02  
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 2.24E+00 2.46E-03 1.64E+00 2.01E+00 1.59E+00 4.19E+00 4.19E+00 9.63E-03 1.17E+00 2.98E+02  
 1.18E+00 1.23E+00  
 2.38E+00 3.63E-03 1.67E+00 2.01E+00 1.59E+00 4.33E+00 4.33E+00 9.35E-03 1.17E+00 2.98E+02  
 1.19E+00 1.24E+00  
 2.54E+00 5.29E-03 1.70E+00 2.02E+00 1.59E+00 4.51E+00 4.51E+00 9.04E-03 1.17E+00 2.98E+02  
 1.21E+00 1.25E+00  
 2.73E+00 7.59E-03 1.74E+00 2.04E+00 1.59E+00 4.72E+00 4.72E+00 8.69E-03 1.17E+00 2.98E+02  
 1.22E+00 1.26E+00  
 2.97E+00 1.08E-02 1.78E+00 2.05E+00 1.59E+00 4.97E+00 4.97E+00 8.30E-03 1.17E+00 2.98E+02  
 1.24E+00 1.28E+00  
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 1.40E+00 1.43E+00  
 6.68E+00 9.19E-02 2.42E+00 2.26E+00 1.59E+00 8.97E+00 8.97E+00 4.77E-03 1.18E+00 2.98E+02  
 1.44E+00 1.46E+00  
 7.72E+00 1.19E-01 2.58E+00 2.32E+00 1.59E+00 1.01E+01 1.01E+01 4.23E-03 1.18E+00 2.98E+02  
 1.49E+00 1.50E+00  
 8.98E+00 1.53E-01 2.77E+00 2.39E+00 1.59E+00 1.15E+01 1.15E+01 3.71E-03 1.18E+00 2.98E+02  
 1.53E+00 1.55E+00

1.05E+01 1.94E-01 2.98E+00 2.48E+00 1.59E+00 1.31E+01 1.31E+01 3.22E-03 1.18E+00 2.98E+02  
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 2.04E+01 4.47E-01 4.23E+00 3.03E+00 1.59E+00 2.38E+01 2.38E+01 1.63E-03 1.18E+00 2.98E+02  
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 3.92E-02 3.22E-01  
 2.04E+00 5.99E-03 5.99E-03 9.84E-01 1.02E-02 1.02E-02 6.55E-03 0.00E+00 0.00E+00 2.17E-01  
 3.94E-02 3.22E-01  
 2.13E+00 5.86E-03 5.86E-03 9.84E-01 1.02E-02 1.02E-02 7.92E-03 0.00E+00 0.00E+00 2.16E-01  
 3.96E-02 3.23E-01  
 2.24E+00 5.72E-03 5.72E-03 9.84E-01 1.02E-02 1.02E-02 9.49E-03 0.00E+00 0.00E+00 2.15E-01  
 3.98E-02 3.24E-01  
 2.38E+00 5.55E-03 5.55E-03 9.84E-01 1.03E-02 1.03E-02 1.13E-02 0.00E+00 0.00E+00 2.14E-01  
 4.01E-02 3.25E-01  
 2.54E+00 5.37E-03 5.37E-03 9.84E-01 1.03E-02 1.03E-02 1.33E-02 0.00E+00 0.00E+00 2.12E-01  
 4.05E-02 3.26E-01  
 2.73E+00 5.16E-03 5.16E-03 9.85E-01 1.03E-02 1.03E-02 1.55E-02 0.00E+00 0.00E+00 2.11E-01  
 4.09E-02 3.27E-01  
 2.97E+00 4.93E-03 4.93E-03 9.85E-01 1.03E-02 1.03E-02 1.79E-02 0.00E+00 0.00E+00 2.09E-01  
 4.13E-02 3.29E-01  
 3.25E+00 4.67E-03 4.67E-03 9.85E-01 1.03E-02 1.03E-02 2.05E-02 0.00E+00 0.00E+00 2.07E-01  
 4.19E-02 3.31E-01  
 3.59E+00 4.40E-03 4.40E-03 9.85E-01 1.03E-02 1.03E-02 2.33E-02 0.00E+00 0.00E+00 2.05E-01  
 4.25E-02 3.33E-01  
 4.00E+00 4.10E-03 4.10E-03 9.86E-01 1.03E-02 1.03E-02 2.62E-02 0.00E+00 0.00E+00 2.03E-01  
 4.33E-02 3.35E-01  
 4.50E+00 3.79E-03 3.79E-03 9.86E-01 1.03E-02 1.03E-02 2.91E-02 0.00E+00 0.00E+00 2.00E-01  
 4.41E-02 3.37E-01  
 5.09E+00 3.47E-03 3.47E-03 9.86E-01 1.03E-02 1.03E-02 3.19E-02 0.00E+00 0.00E+00 1.97E-01  
 4.50E-02 3.40E-01  
 5.81E+00 3.15E-03 3.15E-03 9.87E-01 1.03E-02 1.03E-02 3.47E-02 0.00E+00 0.00E+00 1.94E-01  
 4.61E-02 3.43E-01  
 6.68E+00 2.83E-03 2.83E-03 9.87E-01 1.03E-02 1.03E-02 3.72E-02 0.00E+00 0.00E+00 1.91E-01  
 4.72E-02 3.46E-01  
 7.72E+00 2.51E-03 2.51E-03 9.87E-01 1.03E-02 1.03E-02 3.94E-02 0.00E+00 0.00E+00 1.87E-01  
 4.85E-02 3.49E-01  
 8.98E+00 2.20E-03 2.20E-03 9.88E-01 1.03E-02 1.03E-02 4.13E-02 0.00E+00 0.00E+00 1.84E-01  
 4.99E-02 3.53E-01  
 1.05E+01 1.91E-03 1.91E-03 9.88E-01 1.03E-02 1.03E-02 4.26E-02 0.00E+00 0.00E+00 1.80E-01  
 5.14E-02 3.56E-01  
 1.23E+01 1.64E-03 1.64E-03 9.88E-01 1.03E-02 1.03E-02 4.35E-02 0.00E+00 0.00E+00 1.75E-01  
 5.30E-02 3.59E-01  
 1.45E+01 1.39E-03 1.39E-03 9.88E-01 1.03E-02 1.03E-02 4.38E-02 0.00E+00 0.00E+00 1.71E-01  
 5.47E-02 3.62E-01  
 1.72E+01 1.16E-03 1.16E-03 9.89E-01 1.03E-02 1.03E-02 4.36E-02 0.00E+00 0.00E+00 1.67E-01  
 5.64E-02 3.65E-01  
 2.04E+01 9.64E-04 9.64E-04 9.89E-01 1.03E-02 1.03E-02 4.29E-02 0.00E+00 0.00E+00 1.63E-01  
 5.83E-02 3.68E-01  
 2.42E+01 7.89E-04 7.89E-04 9.89E-01 1.03E-02 1.03E-02 4.16E-02 0.00E+00 0.00E+00 1.58E-01  
 6.02E-02 3.70E-01

2.89E+01 6.38E-04 6.38E-04 9.89E-01 1.03E-02 1.03E-02 3.98E-02 0.00E+00 0.00E+00 1.54E-01  
 6.22E-02 3.72E-01  
 3.45E+01 5.10E-04 5.10E-04 9.89E-01 1.03E-02 1.03E-02 3.77E-02 0.00E+00 0.00E+00 1.50E-01  
 6.43E-02 3.74E-01  
 4.12E+01 4.03E-04 4.03E-04 9.89E-01 1.03E-02 1.03E-02 3.53E-02 0.00E+00 0.00E+00 1.46E-01  
 6.64E-02 3.76E-01  
 4.94E+01 3.15E-04 3.15E-04 9.89E-01 1.03E-02 1.03E-02 3.26E-02 0.00E+00 0.00E+00 1.42E-01  
 6.85E-02 3.77E-01  
 5.92E+01 2.44E-04 2.44E-04 9.89E-01 1.03E-02 1.03E-02 2.99E-02 0.00E+00 0.00E+00 1.38E-01  
 7.07E-02 3.79E-01  
 7.10E+01 1.87E-04 1.87E-04 9.90E-01 1.03E-02 1.03E-02 2.70E-02 0.00E+00 0.00E+00 1.35E-01  
 7.28E-02 3.80E-01  
 8.53E+01 1.42E-04 1.42E-04 9.90E-01 1.03E-02 1.03E-02 2.43E-02 0.00E+00 0.00E+00 1.31E-01  
 7.50E-02 3.81E-01  
 1.02E+02 1.07E-04 1.07E-04 9.90E-01 1.03E-02 1.03E-02 2.16E-02 0.00E+00 0.00E+00 1.28E-01  
 7.72E-02 3.82E-01  
 1.23E+02 7.99E-05 7.99E-05 9.90E-01 1.03E-02 1.03E-02 1.91E-02 0.00E+00 0.00E+00 1.24E-01  
 7.93E-02 3.83E-01  
 1.48E+02 5.93E-05 5.93E-05 9.90E-01 1.03E-02 1.03E-02 1.67E-02 0.00E+00 0.00E+00 1.21E-01  
 8.14E-02 3.83E-01  
 1.78E+02 4.37E-05 4.37E-05 9.90E-01 1.03E-02 1.03E-02 1.46E-02 0.00E+00 0.00E+00 1.18E-01  
 8.35E-02 3.84E-01  
 2.14E+02 3.21E-05 3.21E-05 9.90E-01 1.03E-02 1.03E-02 1.26E-02 0.00E+00 0.00E+00 1.15E-01  
 8.54E-02 3.84E-01  
 2.58E+02 2.35E-05 2.35E-05 9.90E-01 1.03E-02 1.03E-02 1.09E-02 0.00E+00 0.00E+00 1.12E-01  
 8.72E-02 3.85E-01  
 3.11E+02 1.71E-05 1.71E-05 9.90E-01 1.03E-02 1.03E-02 9.36E-03 0.00E+00 0.00E+00 1.09E-01  
 8.89E-02 3.85E-01  
 3.74E+02 1.24E-05 1.24E-05 9.90E-01 1.03E-02 1.03E-02 8.00E-03 0.00E+00 0.00E+00 1.06E-01  
 9.04E-02 3.85E-01  
 4.51E+02 8.98E-06 8.98E-06 9.90E-01 1.03E-02 1.03E-02 6.84E-03 0.00E+00 0.00E+00 1.03E-01  
 9.18E-02 3.85E-01  
 5.43E+02 6.50E-06 6.50E-06 9.90E-01 1.03E-02 1.03E-02 5.84E-03 0.00E+00 0.00E+00 1.01E-01  
 9.28E-02 3.85E-01  
 6.54E+02 4.69E-06 4.69E-06 9.90E-01 1.03E-02 1.03E-02 4.97E-03 0.00E+00 0.00E+00 9.79E-02  
 9.36E-02 3.85E-01  
 7.87E+02 3.39E-06 3.39E-06 9.90E-01 1.03E-02 1.03E-02 4.23E-03 0.00E+00 0.00E+00 9.53E-02  
 9.41E-02 3.84E-01  
 9.49E+02 2.45E-06 2.45E-06 9.90E-01 1.03E-02 1.03E-02 3.54E-03 0.00E+00 0.00E+00 9.27E-02  
 9.42E-02 3.84E-01  
 1.15E+03 1.70E-06 1.70E-06 9.90E-01 1.03E-02 1.03E-02 2.88E-03 0.00E+00 0.00E+00 8.97E-02  
 9.44E-02 3.83E-01  
 1.39E+03 1.18E-06 1.18E-06 9.90E-01 1.03E-02 1.03E-02 2.31E-03 0.00E+00 0.00E+00 8.68E-02  
 9.40E-02 3.82E-01  
 1.69E+03 8.07E-07 8.07E-07 9.90E-01 1.03E-02 1.03E-02 1.86E-03 0.00E+00 0.00E+00 8.38E-02  
 9.30E-02 3.81E-01

2.07E+03 5.51E-07 5.51E-07 9.90E-01 1.03E-02 1.03E-02 1.44E-03 0.00E+00 0.00E+00 8.09E-02  
9.14E-02 3.79E-01  
1

time averaged (tav = 1800. s) volume concentration: concentration contour parameters

$$c(x,y,z,t) = cc(x) * (\text{erf}(xa) - \text{erf}(xb)) * (\text{erf}(ya) - \text{erf}(yb)) * (\exp(-za^*za) + \exp(-zb^*zb))$$

$c(x,y,z,t)$  = concentration (volume fraction) at  $(x,y,z,t)$

$x$  = downwind distance (m)

y = crosswind horizontal distance (m)

$z$  = height (m)

$t$  = time (s)

erf = error function

$$xa = (x - xc + bx) / (sr2 * betax)$$

$$xb = (x - xc - bx) / (sr2 * betax)$$

$$ya = (y+b)/(sr2^*\beta ac)$$

$$yb = (y-b)/(sr2 * betac)$$

`exp = exponential func`

$$za = (z-zc)/(sr2^*sig)$$

$$zb = (z+zc)/(sr2*sig)$$

```
sr2 = sqrt(2.0)
```

1.85E+00 2.32E-03 1.59E+00 7.24E-01 2.31E-04 9.02E-01	3.70E+00 1.85E+00 3.76E+00 3.07E-02
1.90E+00 2.30E-03 1.59E+00 7.28E-01 4.10E-04 9.08E-01	3.79E+00 1.90E+00 3.82E+00 3.12E-02
1.96E+00 2.27E-03 1.59E+00 7.33E-01 6.77E-04 9.16E-01	3.90E+00 1.96E+00 3.89E+00 3.17E-02
2.04E+00 2.24E-03 1.59E+00 7.39E-01 1.07E-03 9.24E-01	4.03E+00 2.04E+00 3.97E+00 3.24E-02
2.13E+00 2.20E-03 1.59E+00 7.46E-01 1.64E-03 9.35E-01	4.19E+00 2.13E+00 4.07E+00 3.32E-02
2.24E+00 2.15E-03 1.59E+00 7.54E-01 2.46E-03 9.47E-01	4.38E+00 2.24E+00 4.19E+00 3.42E-02
2.38E+00 2.11E-03 1.59E+00 7.64E-01 3.63E-03 9.61E-01	4.60E+00 2.38E+00 4.33E+00 3.54E-02
2.54E+00 2.05E-03 1.59E+00 7.76E-01 5.29E-03 9.79E-01	4.87E+00 2.54E+00 4.51E+00 3.68E-02
2.73E+00 1.99E-03 1.59E+00 7.91E-01 7.59E-03 9.99E-01	5.19E+00 2.73E+00 4.72E+00 3.85E-02
2.97E+00 1.92E-03 1.59E+00 8.08E-01 1.08E-02 1.02E+00	5.57E+00 2.97E+00 4.97E+00 4.06E-02
3.25E+00 1.85E-03 1.59E+00 8.29E-01 1.51E-02 1.05E+00	6.03E+00 3.25E+00 5.27E+00 4.31E-02
3.59E+00 1.77E-03 1.59E+00 8.55E-01 2.10E-02 1.08E+00	6.56E+00 3.59E+00 5.64E+00 4.61E-02
4.00E+00 1.68E-03 1.59E+00 8.85E-01 2.89E-02 1.12E+00	7.20E+00 4.00E+00 6.09E+00 4.97E-02
4.50E+00 1.60E-03 1.59E+00 9.22E-01 3.92E-02 1.17E+00	7.94E+00 4.50E+00 6.62E+00 5.41E-02
5.09E+00 1.50E-03 1.59E+00 9.66E-01 5.27E-02 1.22E+00	8.83E+00 5.09E+00 7.26E+00 5.93E-02
5.81E+00 1.41E-03 1.59E+00 1.02E+00 7.00E-02 1.28E+00	9.86E+00 5.81E+00 8.04E+00 6.56E-02
6.68E+00 1.32E-03 1.59E+00 1.08E+00 9.19E-02 1.34E+00	1.11E+01 6.68E+00 8.97E+00 7.33E-02
7.72E+00 1.23E-03 1.59E+00 1.16E+00 1.19E-01 1.42E+00	1.25E+01 7.72E+00 1.01E+01 8.25E-02
8.98E+00 1.15E-03 1.59E+00 1.25E+00 1.53E-01 1.51E+00	1.42E+01 8.98E+00 1.15E+01 9.36E-02
1.05E+01 1.07E-03 1.59E+00 1.36E+00 1.94E-01 1.61E+00	1.61E+01 1.05E+01 1.31E+01 1.07E-01
1.23E+01 9.88E-04 1.59E+00 1.50E+00 2.43E-01 1.73E+00	1.84E+01 1.23E+01 1.51E+01 1.23E-01
1.45E+01 9.14E-04 1.59E+00 1.66E+00 3.01E-01 1.86E+00	2.11E+01 1.45E+01 1.74E+01 1.42E-01
1.72E+01 8.46E-04 1.59E+00 1.85E+00 3.69E-01 2.01E+00	2.41E+01 1.72E+01 2.03E+01 1.66E-01

2.04E+01 7.81E-04 1.59E+00 2.09E+00 4.47E-01 2.18E+00	2.78E+01 2.04E+01 2.38E+01 1.94E-01
2.42E+01 7.20E-04 1.59E+00 2.37E+00 5.36E-01 2.38E+00	3.20E+01 2.42E+01 2.79E+01 2.28E-01
2.89E+01 6.62E-04 1.59E+00 2.71E+00 6.35E-01 2.61E+00	3.69E+01 2.89E+01 3.29E+01 2.69E-01
3.45E+01 6.07E-04 1.59E+00 3.12E+00 7.46E-01 2.87E+00	4.26E+01 3.45E+01 3.90E+01 3.18E-01
4.12E+01 5.53E-04 1.59E+00 3.61E+00 8.67E-01 3.18E+00	4.92E+01 4.12E+01 4.63E+01 3.78E-01
4.94E+01 5.02E-04 1.59E+00 4.21E+00 9.98E-01 3.53E+00	5.69E+01 4.94E+01 5.50E+01 4.49E-01
5.92E+01 4.54E-04 1.59E+00 4.92E+00 1.14E+00 3.93E+00	6.59E+01 5.92E+01 6.56E+01 5.36E-01
7.10E+01 4.07E-04 1.59E+00 5.78E+00 1.29E+00 4.41E+00	7.65E+01 7.10E+01 7.84E+01 6.40E-01
8.53E+01 3.63E-04 1.59E+00 6.82E+00 1.45E+00 4.95E+00	8.87E+01 8.53E+01 9.37E+01 7.65E-01
1.02E+02 3.22E-04 1.59E+00 8.06E+00 1.61E+00 5.59E+00	1.03E+02 1.02E+02 1.12E+02 9.17E-01
1.23E+02 2.83E-04 1.59E+00 9.55E+00 1.78E+00 6.33E+00	1.20E+02 1.23E+02 1.35E+02
1.10E+00	
1.48E+02 2.48E-04 1.59E+00 1.13E+01 1.95E+00 7.18E+00	1.39E+02 1.48E+02 1.61E+02
1.32E+00	
1.78E+02 2.16E-04 1.59E+00 1.35E+01 2.13E+00 8.18E+00	1.62E+02 1.78E+02 1.94E+02
1.58E+00	
2.14E+02 1.88E-04 1.59E+00 1.61E+01 2.31E+00 9.33E+00	1.89E+02 2.14E+02 2.33E+02
1.90E+00	
2.58E+02 1.62E-04 1.59E+00 1.91E+01 2.50E+00 1.07E+01	2.20E+02 2.58E+02 2.80E+02
2.29E+00	
3.11E+02 1.40E-04 1.59E+00 2.28E+01 2.68E+00 1.22E+01	2.57E+02 3.11E+02 3.37E+02
2.75E+00	
3.74E+02 1.20E-04 1.59E+00 2.72E+01 2.87E+00 1.40E+01	3.00E+02 3.74E+02 4.05E+02
3.31E+00	
4.51E+02 1.03E-04 1.59E+00 3.24E+01 3.05E+00 1.61E+01	3.50E+02 4.51E+02 4.88E+02
3.98E+00	
5.43E+02 8.78E-05 1.59E+00 3.86E+01 3.24E+00 1.84E+01	4.09E+02 5.43E+02 5.87E+02
4.79E+00	
6.54E+02 7.50E-05 1.59E+00 4.60E+01 3.42E+00 2.12E+01	4.78E+02 6.54E+02 7.07E+02
5.77E+00	
7.87E+02 6.39E-05 1.59E+00 5.46E+01 3.61E+00 2.44E+01	5.60E+02 7.87E+02 8.51E+02
6.95E+00	
9.49E+02 5.45E-05 1.59E+00 6.49E+01 3.79E+00 2.81E+01	6.55E+02 9.49E+02 1.03E+03
8.37E+00	
1.15E+03 4.64E-05 1.59E+00 7.72E+01 3.98E+00 3.31E+01	6.57E+02 1.15E+03 1.03E+03
1.62E+02	

1.39E+03	3.96E-05	1.59E+00	9.22E+01	4.15E+00	3.91E+01	7.25E+02	1.39E+03	1.03E+03
2.43E+02								
1.69E+03	3.39E-05	1.59E+00	1.10E+02	4.32E+00	4.60E+01	8.08E+02	1.69E+03	1.03E+03
3.17E+02								
2.07E+03	2.90E-05	1.59E+00	1.32E+02	4.48E+00	5.41E+01	9.08E+02	2.07E+03	1.03E+03
3.91E+02								
1								

time averaged (tav = 1800. s) volume concentration: concentration in the z = 1.50 plane.

downwind distance x (m)	time of max conc (s)	cloud duration (s)	effective bbc (m)	average concentration (volume fraction) at (x,y,z) y/bbc= 0.0 0.5 1.0 1.5 2.0 2.5
-1.77E+00	3.01E+02	6.00E+02	1.77E+00	0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
-1.41E+00	3.00E+02	6.00E+02	1.80E+00	1.35E-08 1.25E-08 4.52E-09 1.47E-10 2.14E-13 0.00E+00
-1.06E+00	3.00E+02	6.00E+02	1.82E+00	4.33E-06 3.95E-06 1.42E-06 5.46E-08 1.20E-10 0.00E+00
-7.07E-01	3.00E+02	6.00E+02	1.84E+00	4.00E-05 3.59E-05 1.28E-05 5.69E-07 1.79E-09 0.00E+00
-3.54E-01	3.00E+02	6.00E+02	1.86E+00	1.33E-04 1.18E-04 4.19E-05 2.10E-06 9.04E-09 3.99E-12
1.04E-07	3.00E+02	6.00E+02	1.89E+00	2.85E-04 2.48E-04 8.80E-05 4.92E-06 2.77E-08 1.71E-11
3.54E-01	3.00E+02	6.00E+02	1.91E+00	4.82E-04 4.14E-04 1.46E-04 8.99E-06 6.42E-08 4.35E-11
7.07E-01	3.00E+02	6.00E+02	1.94E+00	7.09E-04 6.00E-04 2.11E-04 1.41E-05 1.24E-07 1.28E-10
1.06E+00	3.00E+02	6.00E+02	1.96E+00	9.53E-04 7.95E-04 2.79E-04 2.01E-05 2.13E-07 2.89E-10
1.41E+00	3.00E+02	6.00E+02	1.99E+00	1.20E-03 9.90E-04 3.46E-04 2.67E-05 3.33E-07 5.86E-10
1.77E+00	3.01E+02	6.00E+02	2.02E+00	1.45E-03 1.18E-03 4.11E-04 3.37E-05 4.86E-07 1.11E-09
1.80E+00	3.01E+02	6.00E+02	2.02E+00	1.47E-03 1.19E-03 4.15E-04 3.42E-05 5.01E-07 1.17E-09
1.85E+00	3.01E+02	6.00E+02	2.03E+00	1.48E-03 1.20E-03 4.17E-04 3.46E-05 5.15E-07 1.22E-09
1.90E+00	3.01E+02	6.00E+02	2.03E+00	1.49E-03 1.20E-03 4.18E-04 3.51E-05 5.32E-07 1.32E-09
1.96E+00	3.01E+02	6.00E+02	2.04E+00	1.50E-03 1.21E-03 4.20E-04 3.56E-05 5.53E-07 1.43E-09
2.04E+00	3.01E+02	6.00E+02	2.04E+00	1.51E-03 1.22E-03 4.23E-04 3.62E-05 5.78E-07 1.53E-09



	4.12E+01	3.13E+02	6.00E+02	6.46E+00	2.83E-04	1.95E-04	6.33E-05	9.68E-06	6.93E-07
2.31E-08									
4.94E+01	3.16E+02	6.00E+02	7.46E+00		2.17E-04	1.49E-04	4.85E-05	7.43E-06	5.34E-07
1.80E-08									
5.92E+01	3.19E+02	6.00E+02	8.67E+00		1.64E-04	1.13E-04	3.67E-05	5.63E-06	4.06E-07
1.38E-08									
7.10E+01	3.22E+02	6.00E+02	1.01E+01		1.23E-04	8.46E-05	2.75E-05	4.21E-06	3.05E-07
1.04E-08									
8.53E+01	3.27E+02	6.00E+02	1.19E+01		9.13E-05	6.28E-05	2.04E-05	3.12E-06	2.26E-07
7.71E-09									
1.02E+02	3.32E+02	6.00E+02	1.40E+01		6.72E-05	4.62E-05	1.50E-05	2.30E-06	1.66E-07
5.68E-09									
1.23E+02	3.39E+02	6.00E+02	1.66E+01		4.90E-05	3.37E-05	1.09E-05	1.68E-06	1.22E-07
4.17E-09									
1.48E+02	3.47E+02	6.00E+02	1.97E+01		3.56E-05	2.45E-05	7.95E-06	1.22E-06	8.83E-08
3.02E-09									
1.78E+02	3.56E+02	6.00E+02	2.34E+01		2.58E-05	1.77E-05	5.75E-06	8.81E-07	6.38E-08
2.18E-09									
2.14E+02	3.68E+02	6.00E+02	2.78E+01		1.85E-05	1.27E-05	4.14E-06	6.35E-07	4.60E-08
1.57E-09									
2.58E+02	3.82E+02	6.00E+02	3.32E+01		1.33E-05	9.15E-06	2.97E-06	4.56E-07	3.30E-08
1.13E-09									
3.11E+02	3.98E+02	6.00E+02	3.95E+01		9.54E-06	6.56E-06	2.13E-06	3.26E-07	2.36E-08
8.08E-10									
3.74E+02	4.18E+02	6.00E+02	4.71E+01		6.82E-06	4.69E-06	1.52E-06	2.33E-07	1.69E-08
5.80E-10									
4.51E+02	4.42E+02	6.00E+02	5.61E+01		4.87E-06	3.35E-06	1.09E-06	1.67E-07	1.21E-08
4.16E-10									
5.43E+02	4.72E+02	6.00E+02	6.69E+01		3.48E-06	2.39E-06	7.76E-07	1.19E-07	8.62E-09
2.97E-10									
6.54E+02	5.07E+02	6.00E+02	7.96E+01		2.49E-06	1.71E-06	5.55E-07	8.50E-08	6.16E-09
2.09E-10									
7.87E+02	5.49E+02	6.00E+02	9.47E+01		1.78E-06	1.22E-06	3.96E-07	6.08E-08	4.40E-09
1.50E-10									
9.49E+02	6.00E+02	6.00E+02	1.12E+02		1.27E-06	8.73E-07	2.83E-07	4.35E-08	3.15E-09
1.08E-10									
1.15E+03	6.57E+02	6.04E+02	1.34E+02		8.80E-07	6.05E-07	1.96E-07	3.01E-08	2.18E-09
7.50E-11									
1.39E+03	7.25E+02	6.13E+02	1.60E+02		6.09E-07	4.19E-07	1.36E-07	2.08E-08	1.51E-09
5.14E-11									
1.69E+03	8.08E+02	6.26E+02	1.91E+02		4.21E-07	2.90E-07	9.40E-08	1.44E-08	1.04E-09
3.60E-11									
2.07E+03	9.08E+02	6.44E+02	2.29E+02		2.92E-07	2.01E-07	6.51E-08	9.98E-09	7.23E-10
2.44E-11									

time averaged (tav = 1800. s) volume concentration: maximum concentration (volume fraction) along centerline.

downwind distance	height	maximum concentration	time of max conc	cloud duration
x (m)	z (m)	c(x,0,z)	(s)	(s)
-1.77E+00	0.00E+00	0.00E+00	3.01E+02	6.00E+02
-1.41E+00	0.00E+00	3.54E-03	3.00E+02	6.00E+02
-1.06E+00	0.00E+00	4.21E-03	3.00E+02	6.00E+02
-7.07E-01	0.00E+00	4.64E-03	3.00E+02	6.00E+02
-3.54E-01	0.00E+00	4.96E-03	3.00E+02	6.00E+02
1.04E-07	0.00E+00	5.21E-03	3.00E+02	6.00E+02
3.54E-01	0.00E+00	5.43E-03	3.00E+02	6.00E+02
7.07E-01	0.00E+00	5.60E-03	3.00E+02	6.00E+02
1.06E+00	0.00E+00	5.75E-03	3.00E+02	6.00E+02
1.41E+00	0.00E+00	5.88E-03	3.00E+02	6.00E+02
1.77E+00	0.00E+00	5.99E-03	3.01E+02	6.00E+02
1.80E+00	0.00E+00	5.94E-03	3.01E+02	6.00E+02
1.85E+00	0.00E+00	5.89E-03	3.01E+02	6.00E+02
1.90E+00	0.00E+00	5.82E-03	3.01E+02	6.00E+02
1.96E+00	0.00E+00	5.74E-03	3.01E+02	6.00E+02
2.04E+00	0.00E+00	5.64E-03	3.01E+02	6.00E+02
2.13E+00	0.00E+00	5.53E-03	3.01E+02	6.00E+02
2.24E+00	0.00E+00	5.41E-03	3.01E+02	6.00E+02
2.38E+00	0.00E+00	5.26E-03	3.01E+02	6.00E+02
2.54E+00	0.00E+00	5.10E-03	3.01E+02	6.00E+02
2.73E+00	0.00E+00	4.91E-03	3.01E+02	6.00E+02
2.97E+00	0.00E+00	4.71E-03	3.01E+02	6.00E+02
3.25E+00	0.00E+00	4.48E-03	3.01E+02	6.00E+02
3.59E+00	0.00E+00	4.24E-03	3.01E+02	6.00E+02
4.00E+00	0.00E+00	3.97E-03	3.01E+02	6.00E+02
4.50E+00	0.00E+00	3.69E-03	3.01E+02	6.00E+02
5.09E+00	0.00E+00	3.39E-03	3.02E+02	6.00E+02
5.81E+00	0.00E+00	3.09E-03	3.02E+02	6.00E+02
6.68E+00	0.00E+00	2.78E-03	3.02E+02	6.00E+02
7.72E+00	0.00E+00	2.46E-03	3.02E+02	6.00E+02
8.98E+00	0.00E+00	2.15E-03	3.03E+02	6.00E+02
1.05E+01	0.00E+00	1.86E-03	3.03E+02	6.00E+02
1.23E+01	0.00E+00	1.57E-03	3.04E+02	6.00E+02
1.45E+01	0.00E+00	1.31E-03	3.05E+02	6.00E+02
1.72E+01	0.00E+00	1.07E-03	3.05E+02	6.00E+02
2.04E+01	0.00E+00	8.66E-04	3.06E+02	6.00E+02
2.42E+01	0.00E+00	6.87E-04	3.08E+02	6.00E+02
2.89E+01	0.00E+00	5.36E-04	3.09E+02	6.00E+02
3.45E+01	0.00E+00	4.13E-04	3.11E+02	6.00E+02
4.12E+01	0.00E+00	3.14E-04	3.13E+02	6.00E+02

4.94E+01	0.00E+00	2.36E-04	3.16E+02	6.00E+02
5.92E+01	0.00E+00	1.76E-04	3.19E+02	6.00E+02
7.10E+01	0.00E+00	1.30E-04	3.22E+02	6.00E+02
8.53E+01	0.00E+00	9.52E-05	3.27E+02	6.00E+02
1.02E+02	0.00E+00	6.94E-05	3.32E+02	6.00E+02
1.23E+02	0.00E+00	5.03E-05	3.39E+02	6.00E+02
1.48E+02	0.00E+00	3.64E-05	3.47E+02	6.00E+02
1.78E+02	0.00E+00	2.62E-05	3.56E+02	6.00E+02
2.14E+02	0.00E+00	1.88E-05	3.68E+02	6.00E+02
2.58E+02	0.00E+00	1.34E-05	3.82E+02	6.00E+02
3.11E+02	0.00E+00	9.61E-06	3.98E+02	6.00E+02
3.74E+02	0.00E+00	6.86E-06	4.18E+02	6.00E+02
4.51E+02	0.00E+00	4.89E-06	4.42E+02	6.00E+02
5.43E+02	0.00E+00	3.49E-06	4.72E+02	6.00E+02
6.54E+02	0.00E+00	2.49E-06	5.07E+02	6.00E+02
7.87E+02	0.00E+00	1.78E-06	5.49E+02	6.00E+02
9.49E+02	0.00E+00	1.27E-06	6.00E+02	6.00E+02
1.15E+03	0.00E+00	8.81E-07	6.57E+02	6.04E+02
1.39E+03	0.00E+00	6.09E-07	7.25E+02	6.13E+02
1.69E+03	0.00E+00	4.22E-07	8.08E+02	6.26E+02
2.07E+03	0.00E+00	2.92E-07	9.08E+02	6.44E+02

**Hazmat Attachment 2**

**MSDS Sheets**



## MATERIAL SAFETY DATA SHEET

### PRODUCT

### NALCO 7330

#### EMERGENCY TELEPHONE NUMBER

(800)462-5378 (24 Hours) (800) I-M-ALERT

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : NALCO 7330

CHEMICAL DESCRIPTION : Water, Substituted isothiazoline

COMPANY IDENTIFICATION :  
Nalco Chemical Company  
One Nalco Center  
Naperville, Illinois  
60563-1198

EMERGENCY TELEPHONE NUMBER : (800)462-5378 (24 Hours) (800) I-M-ALERT

#### NFPA 704M/HMIS RATING

HEALTH : 3 / 3 FLAMMABILITY : 0 / 0 REACTIVITY : 0 / 0 OTHER :  
0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous. Consult Section 15 for the nature of the hazard(s).

Hazardous Substance(s)	CAS NO	% (w/w)
5-Chloro-2-Methyl-4-Isothiazolin-3-one	26172-55-4	1.1
2-Methyl-4-Isothiazolin-3-one	2682-20-4	0.3

## 3. HAZARDS IDENTIFICATION

#### \*\*EMERGENCY OVERVIEW\*\*

#### DANGER

Corrosive. May cause tissue damage. May cause sensitization by skin contact. Toxic to aquatic organisms. Do not get in eyes, on skin, on clothing. Do not take internally. Use with adequate ventilation. Keep container tightly closed and in a well-ventilated place. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. Protect product from freezing. Wear a face shield. Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots. May evolve oxides of carbon (CO<sub>x</sub>) under fire conditions. May evolve HCl under fire conditions. May evolve oxides of nitrogen (NO<sub>x</sub>) and sulfur (SO<sub>x</sub>) under fire conditions.

PRIMARY ROUTES OF EXPOSURE :

Eye, Skin

HUMAN HEALTH HAZARDS - ACUTE :

#### EYE CONTACT :

Corrosive. Will cause eye burns and permanent tissue damage.



## MATERIAL SAFETY DATA SHEET

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**NALCO 7330**

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#### SKIN CONTACT :

May cause severe irritation or tissue damage depending on the length of exposure and the type of first aid administered. Repeated or prolonged contact may cause skin sensitization.

#### INGESTION :

Not a likely route of exposure. Corrosive; causes chemical burns to the mouth, throat and stomach.

#### INHALATION :

Not a likely route of exposure. Irritating, in high concentrations, to the eyes, nose, throat and lungs.

#### SYMPTOMS OF EXPOSURE :

##### Acute :

A review of available data does not identify any symptoms from exposure not previously mentioned.

##### Chronic :

A review of available data does not identify any symptoms from exposure not previously mentioned.

#### AGGRAVATION OF EXISTING CONDITIONS :

A review of available data does not identify any worsening of existing conditions.

## 4. FIRST AID MEASURES

**IF SWALLOWED:** Do not induce vomiting. Drink promptly a large quantity of egg whites, gelatin solution or, if these are not available, drink large quantities of water. Avoid alcohol. Call a physician immediately. Never give anything by mouth to an unconscious person.

**IF INHALED:** Remove immediately to fresh air. If not breathing, apply artificial respiration. If breathing is difficult, give oxygen, and call a physician.

#### NOTE TO PHYSICIAN :

Probable mucosal damage may contraindicate the use of gastric lavage. Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

## 5. FIRE FIGHTING MEASURES

**FLASH POINT :** None

#### EXTINGUISHING MEDIA :

Not expected to burn. Use extinguishing media appropriate for surrounding fire.

#### FIRE AND EXPLOSION HAZARD :

May evolve oxides of carbon (CO<sub>x</sub>) under fire conditions. May evolve HCl under fire conditions. May evolve oxides of nitrogen (NO<sub>x</sub>) and sulfur (SO<sub>x</sub>) under fire conditions.

#### SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING :

In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

**NALCO 7330**

### EMERGENCY TELEPHONE NUMBER

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## 6. ACCIDENTAL RELEASE MEASURES

### PERSONAL PRECAUTIONS :

Restrict access to area as appropriate until clean-up operations are complete. Ensure clean-up is conducted by trained personnel only. Ventilate spill area if possible. Do not touch spilled material. Stop or reduce any leaks if it is safe to do so. Use personal protective equipment recommended in Section 8 (Exposure Controls/Personal Protection). Notify appropriate government, occupational health and safety and environmental authorities.

### METHODS FOR CLEANING UP :

**SMALL SPILLS:** Soak up spill with absorbent material. Place residues in a suitable, covered, properly labeled container. Wash affected area. **LARGE SPILLS:** Dike and absorb with inert material (e.g. dry earth, sand), shovel all contaminated solids into a pail or drum and then treat with enough deactivation solution to wet the solids thoroughly. Let these containers stand open for 48 hours to prevent pressure build up and then seal for disposal. Equipment containing residues should be decontaminated before carrying out maintenance or repair work or using for other service. Contaminated surfaces should be swabbed with deactivation solution, wait for the reaction to subside and rinse thoroughly with clean water. **DEACTIVATION SOLUTION -** prepare fresh by adding 1 part by weight of sodium metabisulphite or sodium bisulphite to 10 parts water. Conduct these operations in a well ventilated area to minimize the risk of inhaling sulphur dioxide. Use at a ratio of 4 parts deactivation solution to 1 part product. The materials and equipment for preparing solutions should be kept available for use in areas where spills may occur. Wash site of spillage thoroughly with water. Contact an approved waste hauler for disposal of contaminated recovered material. Dispose of material in compliance with regulations indicated in Section 13 (Disposal Considerations).

## 7. HANDLING AND STORAGE

### HANDLING :

Do not get in eyes, on skin, on clothing. Do not take internally. Use with adequate ventilation. Avoid generating aerosols and mists. Keep the containers closed when not in use. Have emergency equipment (for fires, spills, leaks, etc.) readily available.

### STORAGE CONDITIONS :

Store the containers tightly closed. Store separately from oxidizers. Store in suitable labelled containers.

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### OCCUPATIONAL EXPOSURE LIMITS :

#### Manufacturer's Recommendation :

##### Substance(s)

5-Chloro-2-Methyl-4-Isothiazolin-3-one	TWA: 0.1000 mg/m <sup>3</sup>
	STEL: 0.30000 mg/m <sup>3</sup>

### ENGINEERING MEASURES :

General ventilation is recommended. Use local exhaust ventilation if necessary to control airborne mist and vapor.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

**NALCO 7330**

### EMERGENCY TELEPHONE NUMBER

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#### RESPIRATORY PROTECTION :

If significant mists, vapors or aerosols are generated an approved respirator is recommended. A dust, mist, fume cartridge may be used. In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.

#### HAND PROTECTION :

Impervious gloves, Butyl gloves, PVC gloves, Neoprene gloves

#### SKIN PROTECTION :

Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots. A full slicker suit is recommended if gross exposure is possible.

#### EYE PROTECTION :

Wear a face shield with chemical splash goggles.

#### HYGIENE RECOMMENDATIONS :

Eye wash station and safety shower are necessary. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

#### HUMAN EXPOSURE CHARACTERIZATION :

Based on our recommended product application and personal protective equipment, the potential human exposure is: Moderate

### 9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE                    Liquid

APPEARANCE                      Light green

ODOR                             Mild

SPECIFIC GRAVITY	1.08
DENSITY	8.6 lb/gal
SOLUBILITY IN WATER	Complete
pH (100 %)	3 - 5
FREEZING POINT	25 °F / -4 °C
VOC CONTENT	0.01 %

### 10. STABILITY AND REACTIVITY

#### STABILITY :

Stable under normal conditions.

#### HAZARDOUS POLYMERIZATION :

Hazardous polymerization will not occur.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

### NALCO 7330

#### EMERGENCY TELEPHONE NUMBER

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#### CONDITIONS TO AVOID :

Freezing temperatures

#### MATERIALS TO AVOID :

Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.

#### HAZARDOUS DECOMPOSITION PRODUCTS :

Under fire conditions: Oxides of carbon, Oxides of nitrogen, Oxides of sulfur

## 11. TOXICOLOGICAL INFORMATION

#### ACUTE ORAL TOXICITY :

Species	LD50	Tested Substance
Rat	3,810 mg/kg	Product

#### ACUTE DERMAL TOXICITY :

Species	LD50	Tested Substance
Rabbit	> 5,000 mg/kg	Product

#### ACUTE INHALATION TOXICITY :

Species	LC50	Tested Substance
Rat	13.7 mg/l ()	1% Active Ingredient

Rating : Toxic

**PRIMARY SKIN IRRITATION :** A 1.5% active solution is corrosive to skin, a 0.6% active solution is a severe skin irritant, a 0.3% active solution is a moderate skin irritant and a 0.06% active solution is a non-irritant.

**PRIMARY EYE IRRITATION :** A 1.5% active solution is corrosive to the eyes, a 0.3% active solution is an eye irritant and 0.06% active solution is a non-irritant.

#### SENSITIZATION :

Repeated or prolonged contact may cause sensitization in some individuals. A Guinea pig (Buehler Technique) sensitization study with an induction dosage of 90 ppm of active ingredients followed by an insult of 429 ppm of active ingredients was positive. A human repeated insult patch study of 28 ppm active ingredients followed by an insult of 56 ppm of active ingredients resulted in no effect to the subjects tested.

#### CHRONIC TOXICITY DATA :

A 90-day dietary study in dogs of 840 ppm of isothiazolinone resulted in no mortalities or pathological findings. A 90-day dermal study in rabbits of 0.4 mg/kg/day of isothiazolinone resulted in irritation but no pathological effects. A 30-month skin painting study with mice using 400 ppm isothiazolinone three times per week showed no increased tumor frequency over control. A teratology study with rabbits and rats was negative using dosages of 1.5 to 15 mg/kg isothiazolinone. Mutagenicity results have been equivocal.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

### NALCO 7330

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#### CARCINOGENICITY :

None of the substances in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the American Conference of Governmental Industrial Hygienists (ACGIH).

#### REPRODUCTIVE EFFECTS :

No data available.

#### HUMAN HAZARD CHARACTERIZATION :

Based on our hazard characterization, the potential human hazard is: High

## 12. ECOLOGICAL INFORMATION

#### ECOTOXICOLOGICAL EFFECTS :

The following results are for the product along with results on the hazardous substances.

#### ACUTE FISH RESULTS :

Species	Exposure	LC50	Tested Substance
Sheepshead Minnow	96.00 hrs	32.000 mg/l	Product
Bluegill Sunfish	144.00 hrs	0.540 mg/l	Active Substance
Fathead Minnow	144 hrs	0.12 mg/l	Active Substance

Rating : Toxic

#### ACUTE INVERTEBRATE RESULTS :

Species	Exposure	LC50	EC50	Tested Substance
Mysid Shrimp (M. bahia)	96.00 hrs	18.000 mg/l		Product
Daphnia magna	48.00 hrs	0.13 - 0.18 mg/l		Active Substance
Ceriodaphnia dubia	48 hrs	15 mg/l		Product

Rating : Toxic

#### AVIAN RESULTS :

Species	Exposure	LC50	Tested Substance
Bobwhite Quail		97.00000 mg/kg	Product
Pekin Duck	8.00 Days	560.00000 mg/kg	Active Substance

#### PERSISTENCY AND DEGRADATION :

Total Organic Carbon (TOC) : 7,850 mg/l

Chemical Oxygen Demand (COD) : 20,000 mg/l

The degradation of the major active substance begins with ring opening and elimination of chloride ion. Degradation leads to the formation of a variety of small organic acids, methylamine, carbon dioxide and elemental sulfur. The half life of each active substance is dependent upon the initial concentration.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

### NALCO 7330

#### EMERGENCY TELEPHONE NUMBER

(800)462-5378 (24 Hours) (800) I-M-ALERT

#### ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION

Based on our hazard characterization, the potential environmental hazard is: High

Based on our recommended product application and the product's characteristics, the potential environmental exposure is: Moderate

If released into the environment, see CERCLA/SUPERFUND in Section 15.

### 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

Metal Containers: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or other procedures approved by state and local authorities. Plastic Containers: PLASTIC CONTAINERS: Do not reuse empty container. Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

### 14. TRANSPORT INFORMATION

Proper Shipping Name / Hazard Class may vary by packaging, properties, and mode of transportation. Typical Proper Shipping Names for this product are:

#### LAND TRANSPORT :

Proper Shipping Name :	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Technical Name(s) :	ISOTHIAZOLINONE MICROBIOCIDE
UN/ID No :	3265
Hazard Class - Primary :	8
Packing Group :	II
Flash Point :	None

#### AIR TRANSPORT (ICAO/IATA) :

Proper Shipping Name :	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Technical Name(s) :	ISOTHIAZOLINONE MICROBIOCIDE
UN/ID No :	3265
Hazard Class - Primary :	8
Packing Group :	II
IATA Cargo Packing Instructions :	812
IATA Cargo Aircraft Limit :	30 L (Max net quantity per package)

#### MARINE TRANSPORT (IMDG/IMO) :

IMDG Page :	8147-1
Proper Shipping Name :	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Technical Name(s) :	ISOTHIAZOLINONE MICROBIOCIDE



## MATERIAL SAFETY DATA SHEET

### PRODUCT

### NALCO 7330

#### EMERGENCY TELEPHONE NUMBER

(800)462-5378 (24 Hours) (800) I-M-ALERT

UN/ID No : 3265  
Hazard Class - Primary : 8  
Packing Group : II

### 15. REGULATORY INFORMATION

#### NATIONAL REGULATIONS, USA :

##### OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200 :

Based on our hazard evaluation, the following substance(s) in this product is/are hazardous and the reason(s) is/are shown below.

5-Chloro-2-Methyl-4-Isothiazolin-3-one : Corrosive, Sensitizer

2-Methyl-4-Isothiazolin-3-one : Corrosive, Sensitizer

##### CERCLA/SUPERFUND, 40 CFR 117, 302 :

Notification of spills of this product is not required.

##### SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312, AND 313 :

##### SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355) :

This product does not contain substances listed in Appendix A and B as an Extremely Hazardous Substance.

##### SECTIONS 311 AND 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370) :

Our hazard evaluation has found this product to be hazardous. The product should be reported under the following EPA hazard categories:

- Immediate (Acute) Health Hazard
- Delayed (Chronic) Health Hazard
- Fire Hazard
- Sudden Release of Pressure Hazard
- Reactive Hazard

Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

##### SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372) :

This product contains the following substance(s), (with CAS # and % range) which appear(s) on the List of Toxic Chemicals

Hazardous Substance(s)	CAS NO	% (w/w)
Magnesium Nitrate	10377-60-3	1.0 - 5.0

##### TOXIC SUBSTANCES CONTROL ACT (TSCA) :

This product is exempted under TSCA and regulated under FIFRA. The inerts are on the Inventory List.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

### NALCO 7330

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#### FOOD AND DRUG ADMINISTRATION (FDA) Federal Food, Drug and Cosmetic Act :

When use situations necessitate compliance with FDA regulations, this product is acceptable under : 21 CFR 176.170 Components of paper and paperboard in contact with aqueous and fatty foods and 21 CFR 176.180 Components of paper and paperboard in contact with dry foods., 21 CFR 176.180 Components of paper and paperboard in contact with dry foods., 21 CFR 176.300 - Slimicides

#### U.S. DEPARTMENT OF AGRICULTURE (USDA) :

USDA Inspection and Grading Programs - Food Safety and Inspection Service:

This product is authorized by USDA for use in federally inspected meat and poultry plants. Authorized use is under category : G7

This product has been certified as KOSHER/PAREVE for year-round use INCLUDING THE PASSOVER SEASON by the CHICAGO RABBINICAL COUNCIL.

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15 / formerly Sec. 307, 40 CFR / formerly Sec. 311 :

This product contains the following substances listed in the regulation:

<u>Substance(s)</u>	<u>Citations</u>
Cupric Nitrate :	Sec. 311, Sec. 307

CLEAN AIR ACT, Sec. 111 (40 CFR 60, Volatile Organic Compounds), Sec. 112 (40 CFR 61, Hazardous Air Pollutants), Sec. 602 (40 CFR 82, Class I and II Ozone Depleting Substances) :

None of the substances are specifically listed in the regulation.

#### CALIFORNIA PROPOSITION 65 :

This product does not contain substances which require warning under California Proposition 65.

#### MICHIGAN CRITICAL MATERIALS :

This product contains the following substances listed in the regulation:

Copper

#### STATE RIGHT TO KNOW LAWS :

The following substances are disclosed for compliance with State Right to Know Laws:

Copper	7440-50-8
Magnesium Nitrate	10377-60-3

#### NATIONAL REGULATIONS, CANADA :

#### WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) :

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

#### WHMIS CLASSIFICATION :

Pesticide controlled products are not regulated under WHMIS.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

**NALCO 7330**

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### CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) :

All substances in this product are listed on the Domestic Substances List (DSL), are exempt, or have been reported in accordance with the New Substances Notification Regulations.

### **16. OTHER INFORMATION**

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

- \* The human risk is: Moderate
- \* The environmental risk is: Moderate

Any use inconsistent with our recommendations may affect the risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

### REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH., (Ariel Insight™ CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (TOMES CPS™ CD-ROM Version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (TOMES CPS™ CD-ROM Version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA), (Ariel Insight™ CD-ROM Version), Ariel Research Corp., Bethesda MD.

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, OH, (TOMES CPS™ CD-ROM Version), Micromedex, Inc., Englewood, CO.



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Ariel Insight™ (An integrated guide to industrial chemicals covered under major regulatory and advisory programs), North American Module, Western European Module, Chemical Inventories Module and the Generics Module (Ariel Insight™ CD-ROM Version), Ariel Research Corp., Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, WA (TOMES CPS™ CD-ROM Version), Micromedex, Inc., Englewood, CO

Prepared By : Product Safety Department

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